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AN INVESTIGATION IN PULPWOOD PRODUCTION FROM ROUND AND TURPENTINED LONGLEAF PINE

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FOREWORD

Many owners of small as well as of large tracts of forest land in the South are seriously interested in managing their properties for continuous production of sawtimber, naval stores and other forest products. In order to furnish them with authoritative information regarding incomes, costs and most profitable methods of sustained yield forest management, the Division of Economics of the Southern Forest Experiment Station is making comprehensive studies for specific sets of conditions in the different forest regions of the South. The study reported in this paper is one of these and is concerned chiefly with an investigation of pulpwood production in the longleaf-slash pine forest region.

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By: R. E. Worthington, Associate Forest Economist,
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I. INTRODUCTION

The present publication reports on an investigation of pulpwood production from round and turpentined longleaf pine made in a locality tributary to a paper mill in the longleaf-slash pine type. This investigation is the first of a series planned to cover all southern forest types in which pulpwood is cut extensively. These studies have the following major objectives: (1) To determine costs under present methods of pulpwood production; (2) To determine stumpage values for specific conditions; (3) To develop improvements in operating equipment and methods, which will reduce operating expense or eliminate waste; and (4) To establish the most profitable utilization practices through comparison of production costs and market values for the various products of timber stands. The present report covers the first two objectives and suggests some improvements in equipment and methods. It is hoped to prove them in later studies. The fourth objective is not covered because production cost data bearing on other products than pulpwood are not yet available.

Pulpwood as a Product of Naval Stores Stands

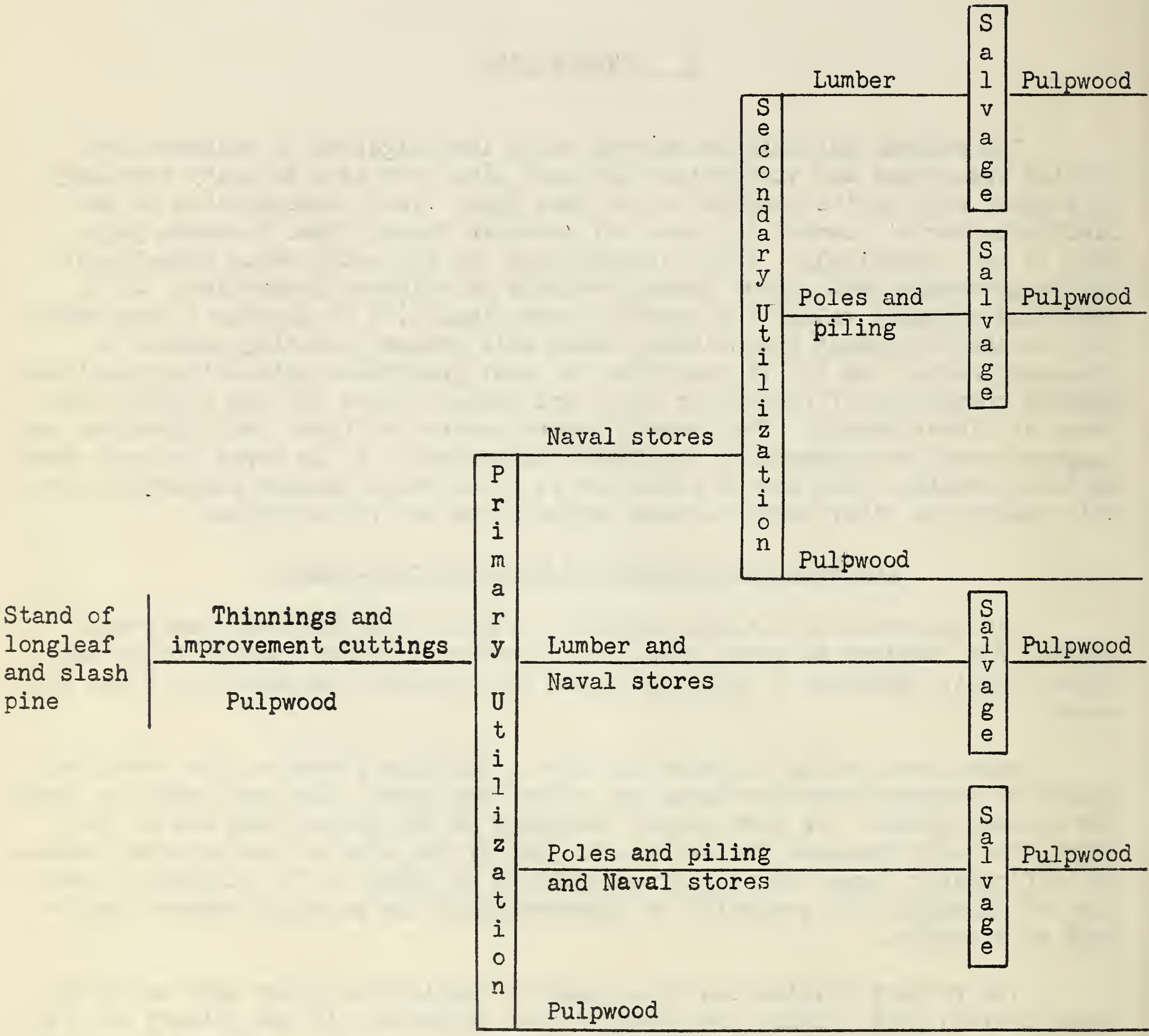
The accompanying diagram, figure 1, illustrates different management schemes for longleaf or slash pine. This portrayal is not assumed to be complete, but it indicates a prominent place for pulpwood combined with other products.

Where seed supply is ample and fire protection adequate, the resultant stands of southern pine seedlings are often very dense - in many cases too dense for optimum growth. In such stands thinnings of the proper kind and at the right time will increase the net growth, and if the size of the material removed is sufficiently large, there is a possibility of using it for pulpwood. The time of thinning will generally be deferred until the material removed can be sold at a profit.

The primary utilization of a stand of longleaf or slash pine may be for naval stores, logs, piling and poles, or for pulpwood. If the primary utilization is for naval stores, the worked-out timber may later be removed in the form of logs, poles and piling, or pulpwood, or a combination of these. Pulpwood may also be salvaged from the tops of trees cut for logs or for piling.

Figure 1.

Illustration of place of pulpwood in the management of longleaf and slash pine



The opinion is current that raising timber for naval stores may well be less profitable in the future than at the present time or in the recent past because of the increasing supply of suitable turpentine stands and the large remaining supply of virgin stumps available for distillation. It may be advisable to use part of one's timber stands or timber lands primarily for the production of lumber or piling. Trees intended for this type of utilization may be worked for naval stores for a few years before cutting; they may form the stand of a certain area, or may be selected individuals in the area devoted to naval stores production.

Selection of pulpwood as the primary yield occurs seldom at present except where, for example, unstable ownership of certain young stands makes it desirable to convert the investment into cash.

Location and Scope of Investigation

The present investigation in pulpwood production was made in the summer of 1934 in turpentined stands of longleaf pine in the longleaf-slash pine type of the Lower Coastal plain. For the most part only worked-out timber was cut, though, through lack or disregard of cutting instructions, some small round timber was also utilized. The cutting data are based upon one day's work for each of eight crews of pulpwood cutters. Seven were two-man crews: the eighth was a three-man crew. Approximately two-thirds of the cutters were white, the rest were colored. There are five tracts represented, on two of which the logs and piling were removed prior to cutting pulpwood. On the remaining three, pulpwood was the only product. The pulpwood cut during the investigation was sold to a local paper mill.

Time requirements for pulpwood cutting expressed in man-hours per cord of 160 cubic feet and per 100 cubic feet of wood 1/ are based upon intensive time studies and measurements of output for trees of different diameter classes, 2/ for the eight crews of pulpwood cutters working in longleaf pine ranging in diameter from 5 to 14 inches. Time required 3/ for each individual operation in

1/ The cord of 160 cubic feet is equivalent to a stack of wood eight feet in length and four feet in height composed of pieces five feet in length. The unit of 100 cubic feet, solid volume, is used to permit comparison between different forest products and between the same product in different localities. For example, the production cost of logs per 100 cubic feet may be compared with that of pulpwood even though the accepted unit of measure for logs is the board foot and for pulpwood the stacked cord. Of course, bark is disregarded in volume computations for the unit of 100 cubic feet of wood.

2/ As diameter breast high cannot be directly measured on turpentined trees because of distortion from growth after turpentining, it must be estimated. In the present report it was determined by increasing the value of the tree diameter at 10 feet above the ground by 9 percent which represents the average relationship between diameters at these two heights for unturpentined trees.

3/ All time of the working day is included in these computations; that is, actual working time plus the prorated portion of the time for rests and delays.

Table 1. - Pulpwood volume table for round and turpentined longleaf pine where all turpentined butts are utilized.

D.b.h. 1/	Basis	Average used length 2/	Top diameter o.b. 3/	Pulpwood volume i.b. 4/	Pulpwood volume o.b. 3/	Ratio of pulpwood vol. o.b. 3/ to vol. of entire tree	Trees per cord of 160 cu. ft. of rough wood
Inches	No. of trees	Feet	Inches	Cu.ft.	Cu.ft.	Percent	Number
5	14	18	3.8	1.7	2.0	82.2	57.2
6	24	26	3.9	3.4	3.9	83.5	29.3
7	34	33	4.1	5.4	6.2	84.4	18.5
8	39	39	4.2	7.8	8.9	85.2	12.9
9	54	44	4.4	10.6	12.0	85.7	9.5
10	37	48	4.6	13.7	15.5	86.2	7.4
11	36	50	4.7	17.0	19.1	86.5	6.0
12	16	52	5.0	20.4	22.7	86.7	5.0
13	8	53	5.2	24.0	26.5	86.9	4.3
14	6	54	5.6	28.4	31.1	87.0	3.7
	268						

1/ Diameter at breast height - $4\frac{1}{2}$ feet above the ground.
2/ Used length means the length of the tree between the stump and the last cut. This length was utilized only when the tree was round or when the turpentined butt was used.
3/ O.b. = outside bark. Limbs are excluded from volume computations.
4/ I.b. = inside bark.

Table 2. Utilization of turpentined timber studied

D.b.h.	Trees studied	Tree with discarded bolts	Turpentined bolts trimmed	Possible pulpwood volume 1/		Tree volume utilized 3/
				Discarded	Utilized 2/	
Inches	Number	Number	Number	Percent	Percent	Percent
6	9	5	0	14.4	85.6	67.2
7	13	8	8	14.3	85.7	69.5
8	32	22	9	14.1	85.9	71.3
9	33	22	10	13.7	86.3	73.5
10	50	36	19	13.1	86.9	75.2
11	33	22	10	12.1	87.9	76.6
12	26	16	10	10.8	89.2	77.7
13	12	6	7	8.9	91.1	78.5
14	9	3	5	6.0	94.0	79.2
	217	140	78			

1/ These percentages were computed from volume used and discarded in each diameter class.
2/ Ratio which actual used-volume bears to volume that would have been utilized if no turpentined bolts had been rejected.
3/ Percentage used-volume bears to entire tree-volume outside bark.

The two bolts nearest the stump received one of the following treatments: (1) Discarded, (2) trimmed and taken, or (3) taken without trimming. Hence figures in column 2 are not the sum of corresponding figures in columns 3 and 4.

pulpwood cutting is shown separately for trees of different diameters. Cutting costs, based on the average rate of earnings for the cutting crews studied, are shown per stacked cord of 160 cubic feet of rough wood and per unit of 100 cubic feet, solid volume, of wood without bark.

Pulpwood transportation by truck, including loading, unloading and hauling, is expressed in the time required and the consequent cost for given hauling distances. Cutting and trucking are the two phases of pulpwood production which place the product at a point where a market value can be applied. This point may be the woodyard of the paper mill or the point of transshipment at railroad or waterway. The difference between sales price and production cost including supervision and incidental costs, represents the sum from which the landowner receives his stumpage and from which the contractor derives his profit and his compensation for risk.

Volume Table and Converting Factor

The results in table 1 are based upon the measurements made of the trees studied in this investigation. Data from this local volume table were used in the computation of tree volumes for this report. The ratio of pulpwood volume to the volume of the entire tree, shown in column 7, is a measure of the relative completeness of utilization. It is quite reasonable to suppose that, as tree diameter increases, the relative degree of utilization should increase as well. The average stump-height for all trees cut was 2.3 feet.

Tree volumes in this study were computed in terms of solid instead of stacked measure. A converting factor is needed to compare cost in terms of solid volume with price in terms of stacked volume. The individual bolts in 6 stacks of pulpwood, comprising approximately 14 cords of 160 cubic feet, were measured. Each stack was selected on the basis of uniformity of bolt size; the average bolt diameter ranged from 4.7 to 16.5 inches. The percentage of solid volume (including bark) per stack varied from 66.1 to 74.3. There was no apparent general trend from one stack to another ranked in order of their average bolt diameters. The average, 71.5 percent, is used in the present report as the relationship of solid to stacked volume for bolts of all diameters.

Two Classifications of Timber Based on Disposal of Turpentined Butts

Most of the timber of this study had been turpentined. If the turpentined portion of these trees had been fire-scarred, in many instances, part or all of the butt was discarded. Table 1, therefore, does not give actual pulpwood volumes under conditions which were encountered. Table 2 is designed to show the extent to which turpentined butts were discarded and the effect on the volume of pulpwood obtained from trees of different diameters. Utilization of the turpentined timber would be regarded as complete if the entire bole suitable for pulpwood were used - in that case each figure in column 6 would be 100.4/ Table 2 represents conditions in a definite locality under certain utilization practices and does not have any general application.

4/ This statement ignores variations in volume due to the "flattened" character of the butts of turpentined trees and assumes that stump heights and unused top lengths would remain unchanged.

Two classifications of pulpwood timber are made in the presentation of cutting data in the present report: Class I, round timber and turpentined timber whose butts were included in the output without trimming of fire-scarred wood; Class II, turpentined timber whose butts were given one of the following treatments for at least a portion of their length: (1) discarded as waste, (2) trimmed and included in the output.

Percentage of Wood and Bark in Pulpwood

Table 3 gives the percentages of wood and of bark in the pulpwood contents of the trees of this investigation. These percentages are not the same as the percentages for unturpentined timber with the same stump heights and top lengths because the discarded turpentined bolts are not included in the calculation and because no allowance is made for the absence of bark on the turpentined faces of used bolts.

II. DESCRIPTION OF OPERATIONS

Pulpwood shipped to the paper mill was supplied almost entirely by contractors. Pulpwood cutting was contracted on a piece-rate basis to cutters who furnished their own tools; the hauling was sometimes sublet to truck owners who drove their own trucks, but usually hauling was done in trucks owned by the contractor or sub-contractor. A foreman was hired to look after the operation if its size warranted it.

Payment for pulpwood delivered at the mill was based on the stacked cord of 160 cubic feet. Deliveries of wood from the sub-contractor were made on this same unit of measurement. Payment to pulpwood cutters for their output was usually on the basis of the number of pens 5/ prepared.

The operations involved in converting standing timber into pulpwood laid down in the woodyard of the mill may be placed under two general heads: (1) Cutting and (2) transport. Within the range of the present investigation, pulpwood production was conducted in the following general manner which may be considered fairly typical of methods in use in turpentined timber in the longleaf-slash pine type.

Cutting

The actual cutting of the timber into pulpwood bolts was done by a crew consisting of two men, usually, though crews of three men were common and sometimes four men worked together. After a tree was felled, limbing and bucking were done in a number of different ways. Sometimes the crew moved toward the top of the tree bucking the bolts as they progressed. When the tree trunk required limbing, the axe-man of the crew limbed a bolt length or more in advance of bucking. Saw pinching was overcome by wooden wedges, by the axe handle used as a lever, or by a specially built "pry-pole." In some cases after the tree was felled and one or two bolts were cut, one man marked and limbed to the limit of utilization, while the second trimmed the charred wood and ingrown bark from turpentined bolts.

5/ The pen, as the term is applied to pulpwood measurement in the South, is a crib of wood six feet in height, with two pieces in each layer.

Table 3. - Percentage [1] of wood and of bark based on rough pulpwood volume of longleaf pine

D. b. h.	Wood	Bark
Inches	Percent	
5	85.4	14.6
6	86.0	14.0
7	86.7	13.3
8	87.3	12.7
9	88.0	12.0
10	88.6	11.4
11	89.3	10.7
12	89.9	10.1
13	90.6	9.4
14	91.2	8.8

1/ These percentages were computed from the volumes inside and outside the bark of that portion of the trees which was used for pulpwood. Stumps, tops, and discarded turpentined bolts are not included. Absence of bark on portions of used bolts was ignored.

The decision on the part of the cutters as to whether or not to trim a turpentined bolt so it would be acceptable by the mill did not rest on any fixed rule. When the landowner did not insist upon this portion of the tree being utilized, it was usually a matter of judgment on the part of the cutters as to whether there would be a greater return with less effort by salvaging the worked-out part of the tree than by cutting additional timber. Where disposition of this portion of the bole was the cutter's option, it was usually utilized if only one face required trimming. If two or more faces needed treatment, the bolt was usually rejected. In those cases where the turpentined faces had not been damaged by fire, it was necessary only to knock off the tins and spikes if they remained after the naval stores operator had abandoned the tree. In this locality, the tin aprons had been inserted in slits prepared with a broad-axe - no tins were nailed to the trees. Quite generally, the discarded bolt was cut five feet long, the same length as the pulpwood bolts. In part, perhaps, this was due to the habit of the cutters who used their saw or a stick for measuring, but a stump two to three feet high and five feet of discarded bolt covered most, if not all, of the turpentined faces which were usually not more than eight or nine feet in height.

None of the bolts of worked-out timber were split, except in the work of one three-man crew. Though many of the bolts exceeded the maximum diameter limit of 12 inches, pieces several inches larger than this limit were accepted by the paper company in the round. Thus, splitting, which is a time-consuming part of pulpwood cutting in trees of large diameter, was of little importance in the present study. All wood was delivered to the mill unpeeled. The bark was removed just before chipping.

In most cases the pulpwood cut was penned by the cutters; in such instances, penning was considered a part of the cutting operation. On one tract the cutters left the pulpwood bolts lying on the ground and were paid on the

basis of the number of bolts cut. Trucks are loaded much more readily from pens because the wood is concentrated and much of it lies at a convenient height for loading. Loading from pens eliminates many moves of the truck and reduces considerably the distance that the loaders must travel to complete the load.

Transport

The initial means of pulpwood transportation in all cases studied was the $1\frac{1}{2}$-ton motor truck. In some instances the truck was driven directly to the mill with its load. Since the timber which lay within the radius of profitable truck haul of the mill had been largely cut away, it was more common to use the truck as a supplement to the railroad car or barge, or to both. In such instances, the truck was employed to relay the wood from the place of cutting to a loading point on a railroad or waterway.

Loading and unloading trucks, freight cars, and barges was done wholly by hand labor though the unloading was expedited for carloads and bargeloads at the woodyard of the mill through the use of conveyors.

III. RESULTS OF INVESTIGATION

Cutting

The volume basis for the information shown in Tables 4, 5, 7, and 8 is shown in the following text table:

Cutting crews	(number)	8
Trees		
Round	(number)	51
Turpentined	(number)	217
Total	(number)	268
Volume outside bark 1/		
Pulpwood	(cu.ft.)	3,362
Pulpwood	(cords) 2/	29.4
Discarded bolts	(cu.ft.)	390
Discarded bolts	(cords)	3.4
Total	(cu.ft.)	3,752
Total	(cords)	32.8

1/ Volume between stump and last cut.
2/ Cord of 160 cubic feet of rough wood.

Cutting for Class I.[6] Pulpwood Timber

Itemized costs in man-hours for cutting round trees and turpentined trees whose butts were included in the output without trimming are given in table 4.

Since the three operations of pulpwood cutting - felling, bucking, and limbing are itemized, a fairly accurate estimate may be made, if desired, of the probable time and cost of cutting southern pines of the non-turpentined

6/ Defined on page 5.

species. If height and form of the trees are assumed to be like those here reported, the only operation that is apt to be appreciably different is limbing. Undoubtedly it will be greater in shortleaf, loblolly, or pond pines. But even if limbing time were doubled to allow for bushier crowns, the cutting cost would not be appreciably changed. It is therefore reasonable to assume that on this basis a fair estimate of relative cost of cutting is possible for those pine species for which no cutting data were taken.

The contents of table 4 are shown in graphic form in figure 2.[7/] The time requirements for penning [8/] are also included, in order to arrive at a value for total time for cutting. This illustrates the comparative time-requirements of the three operations of pulpwood cutting. Bucking is the major one and felling exceeds limbing. This relationship of limbing and felling might readily be reversed with open-grown longleaf pine or with pine species having larger crowns.

Cutting for Class II.[9/] Pulpwood Timber

In the present study there were few round trees and the turpentined timber lost some of its volume in the turpentined bolts which were discarded. The time required for cutting and trimming pulpwood from turpentined timber is shown in table 5. The cutting time per unit volume for trees of each size is increased over the required time for round timber given in table 4 not only because of the reduced volume per tree due to discarding a portion of the turpentined butt, but also because of the time required to trim some of the bolts included in the output. The trimming time per turpentined bolt, 0.05 man-hours, was taken as the same in all diameter classes. Twice as much time was required to prepare pulpwood from 6-inch trees as from 14-inch trees.

Penning Pulpwood

The time required to build pens of pulpwood was also assumed for purposes of this report to be the same per unit volume for trees of all sizes. This was 1.07 man-hours per cord of 160 cubic feet or 1.06 man-hours per 100 cubic feet of wood alone - solid volume.

7/ In figure 2 the values in man-hours per unit of volume for each curve are read directly from the scale on the side of each graph. Cutting in the upper portion of the figure is the sum of felling, bucking, and limbing; in the lower part of the figure, cutting includes felling, bucking, limbing, and trimming of turpentined bolts which are not shown separately. Penning is not shown by itself in figure 2; it is assumed to be the same per cord or per unit of 100 cubic feet for all diameter classes - see paragraph on "Penning Pulpwood."
8/ See paragraph on "Penning Pulpwood."
9/ Defined on page 5.

Table 4. - Time[1] in man-hours for felling, bucking,[2] and limbing pulpwood

Class I.[3] Pulpwood Timber

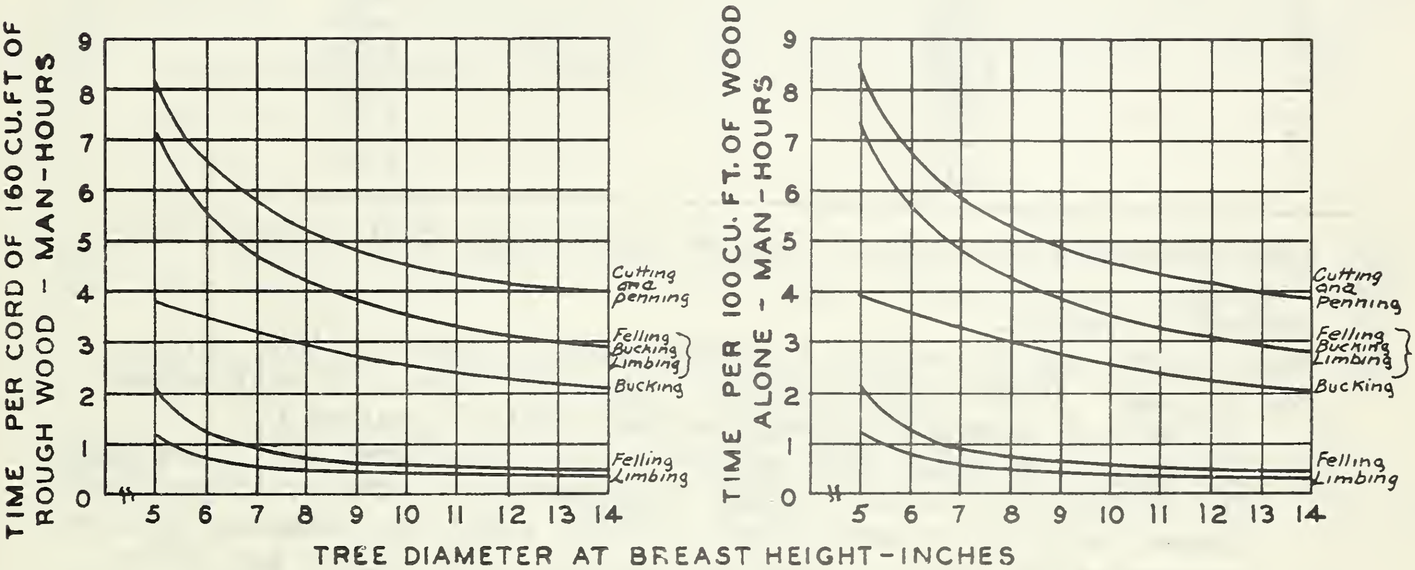
Cutting Operation	Man-hours per cord of 160 cubic feet of rough wood									
	By tree diameters in inches (d.b.h.)									
	5	6	7	8	9	10	11	12	13	14
Felling	2.15	1.25	0.92	0.75	0.64	0.57	0.52	0.50	0.48	0.45
Bucking	3.82	3.57	3.27	2.98	2.73	2.51	2.38	2.28	2.18	2.08
Limbing	1.20	0.76	0.58	0.50	0.45	.42	0.40	0.39	0.39	0.39
Total	7.17	5.58	4.77	4.23	3.82	3.50	3.30	3.17	3.05	2.92
	Man-hours per 100 cubic feet of wood only - solid volume									
Felling	2.20	1.28	0.92	0.73	0.63	0.57	0.50	0.48	0.47	0.43
Bucking	3.90	3.62	3.28	2.98	2.70	2.48	2.33	2.23	2.11	2.00
Limbing	1.23	0.78	0.60	0.52	0.45	0.42	0.40	0.37	0.37	0.37
Total	7.33	5.68	4.80	4.23	3.78	3.47	3.23	3.08	2.95	2.80

1/ Time required for a crew of two men would be one half of these man-hour values.
2/ These data are based on pulpwood cutting where the bolts were cut five feet long. If the bolts were cut some other length the bucking time given above would not apply. It is estimated that if the bolt-length were four and one half feet the values for bucking would be increased about 11 percent; if the bolt-length were four feet, bucking time would be increased about 23 percent.
3/ Defined on page 5.

FIG. 2

TIME FOR CUTTING PULPWOOD

CLASS I FOR ROUND AND TURPENTINED LONGLEAF PINE WHEN ALL TURPENTINED BOLTS ARE TAKEN WITHOUT BEING TRIMMED.



CLASS II FOR TURPENTINED LONGLEAF PINE - ACTUAL CONDITIONS AS FOUND IN THE STUDY, SOME TURPENTINED BOLTS TAKEN, SOME DISCARDED, SOME TRIMMED, AND SOME NOT TRIMMED.

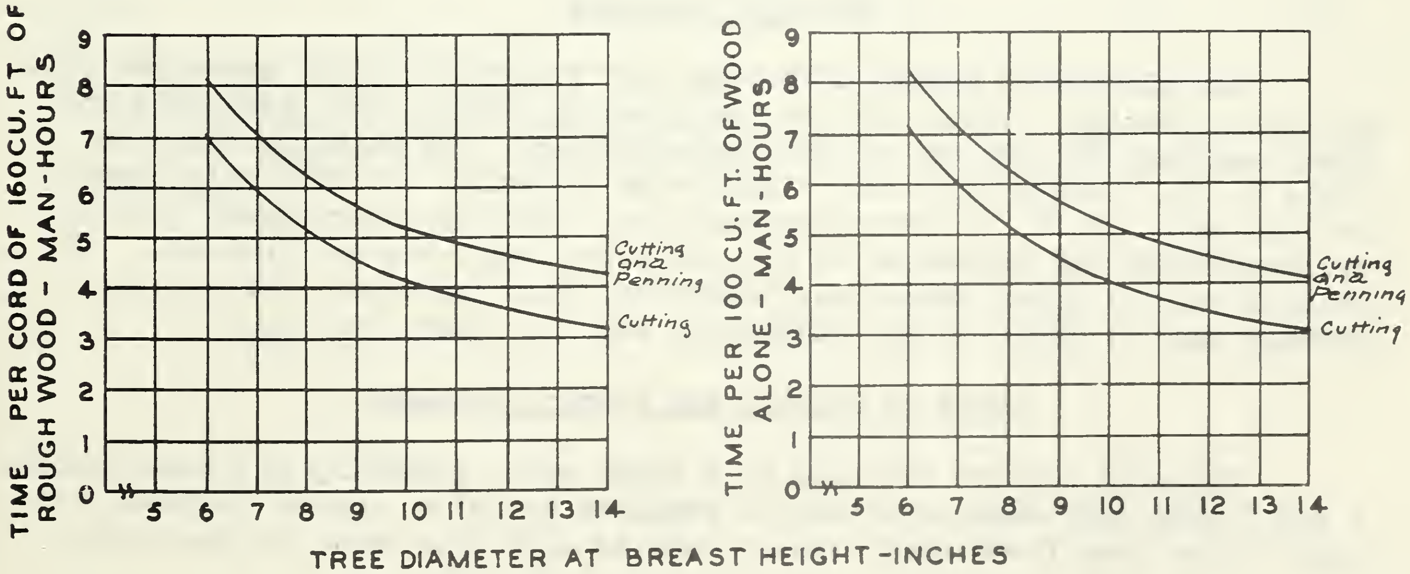


Table 5. - Time in man-hours[1] for felling, bucking, limbing, and trimming pulpwood

Class II.[2] Pulpwood Timber

D.b.h.	Cutting and trimming time [3]	
	Per cord of 160 cu. ft. of rough wood	Per 100 cu. ft. of wood only - solid volume
Inches	Man-hours	
6	7.05	7.16
7	5.98	6.03
8	5.17	5.18
9	4.59	4.56
10	4.18	4.12
11	3.87	3.78
12	3.66	3.56
13	3.45	3.33
14	3.19	3.06

1/ Time required for a crew of two men would be one half of these man-hour values.

2/ Defined on page 5.

3/ These values may be derived for each diameter class in this way:

(a) Cutting - Divide corresponding values of table 4 by utilization percent of possible pulpwood volume, table 2, column 6.

(b) Trimming - Multiply 0.05 man-hours per turpentined bolt (see page 9) by ratio of curved values of turpentined bolts to turpentined trees, table 2, columns 4 and 2. This result is trimming time in man-hours per tree. Change to man-hours per cord or per 100 cubic feet of wood alone by use of volumes of table 1, columns 6 and 5 respectively, decreased by the utilization percent of table 2, column 6.

(c) Cutting and Trimming - is the sum of (a) and (b).

Cutters' Earnings

The piece-work system of payment for pulpwood cutting prevailed with all crews studied. Table 6 lists the crews by number, the piece-rate and their earnings for the day of the investigation. The earnings shown in table 6 - 14.7 cents per hour - include an allowance for tool maintenance and depreciation of 1.7 cents per man-hour. Cost of supervision, paid by the contractor and estimated at 0.9 cents per hour, was not included. The rate of pay for labor alone was, therefore, 13.0 cents per hour and the average cost of labor to the contractor was 15.6 cents per hour.

Costs of Cutting and Penning Pulpwood

Pulpwood cutters are paid at a fixed rate, generally per pen. Tables 4 and 5 show that much more time is required to cut a cord of pulpwood from small trees than from large trees. This is also true when the pen rather

than the cord is the unit of measure. Only by cutting in all diameters are laborers' earnings kept uniform. If timber of the smaller diameter classes alone were cut, the earnings of the cutters would be greatly reduced. Unless they would continue to work at reduced wages, thereby shouldering the extra cost themselves, the contract rate of the cutters would have to be increased. Similarly, if trees of the larger diameter classes alone were cut, the cutters' earnings would be advanced above the general wage level and the contractor would be paying more than average to have the pulpwood cut. The rate paid per pen is therefore actually controlled by the earnings of the cutters and in the last analysis by the size of the timber cut. In order to obtain comparable costs of cutting and penning pulpwood from trees of various sizes the average hourly wage (table 6) was applied to the man-hours (tables 4 and 5) required to cut and pen pulpwood in each diameter class. The results (tables 7 and 8) are the total costs to the contractor, including labor, tools, and supervision by the foreman in charge of the operation. The results bring out the fact that costs of producing pulpwood are much greater in small than in large diameter classes. The costs for 6-inch trees are about double those for 14-inch trees.

Table 6. - Gross daily earnings and hours of pulpwood cutters - for the day of the time-study in each case - cutting round and turpentined longleaf pine

Crew Number	Contract rate	Men per crew	Total time worked 1/	Total earnings per crew 2/	Rate per man-hour	Daily earnings per man
		Number	Hours			
4	70¢ per 100 bolts	2	8.9	$2.37	$0.133	$1.18
5	18¢ per pen	3	8.3	2.96	.119	.99
6	20¢ per pen	2	8.7	3.60	.207	1.80
7	20¢ per pen	2	8.9	1.53	.086	.77
8	20¢ per pen	2	9.3	2.20	.118	1.10
9	20¢ per pen	2	8.4	3.88	.231	1.94
10	20¢ per pen	2	6.3	1.73	.137	.86
Average			8.4	2.46	.147	1.23

1/ Excluding time spent filing tools.
2/ These earnings include the cost of tools and their upkeep which must be deducted to obtain the rate of payment for labor alone which averages $0.13 per man-hour.

Table 7 - Time and cost[1] of pulpwood cutting

Class I.[2] Pulpwood Timber

D.b.h.	Per cord of 160 cu. ft. of rough wood				Per 100 cu. ft. of wood only - solid volume			
	Time		Cost		Time		Cost	
	Cutting	Cutting and penning[3]	Cutting	Cutting and penning[3]	Cutting	Cutting and penning[3]	Cutting	Cutting and penning[3]
Inches	Man-hours		Dollars		Man-hours		Dollars	
5	7.17	8.24	1.12	1.28	7.33	8.39	1.14	1.31
6	5.58	6.65	.87	1.04	5.68	6.74	.89	1.05
7	4.77	5.84	.74	.91	4.80	5.86	.75	.92
8	4.23	5.30	.66	.83	4.23	5.29	.66	.83
9	3.82	4.89	.60	.76	3.78	4.84	.59	.76
10	3.50	4.57	.55	.71	3.47	4.53	.54	.71
11	3.30	4.37	.51	.68	3.23	4.29	.50	.67
12	3.17	4.24	.49	.66	3.08	4.14	.48	.65
13	3.05	4.12	.48	.64	2.95	4.01	.46	.63
14	2.92	3.99	.46	.62	2.80	3.86	.44	.60

Table 8. - Time and cost[1] of pulpwood cutting

Class II.[2] Pulpwood Timber

D.b.h.	Per cord of 160 cu. ft. of rough wood				Per 100 cu. ft. of wood only - solid volume			
	Time		Cost		Time		Cost	
	Cutting	Cutting and penning[3]	Cutting	Cutting and penning[3]	Cutting	Cutting and penning[3]	Cutting	Cutting and penning[3]
Inches	Man-hours		Dollars		Man-hours		Dollars	
6	7.05	8.12	1.10	1.27	7.16	8.22	1.12	1.28
7	5.98	7.05	.93	1.10	6.03	7.09	.94	1.11
8	5.17	6.24	.81	.97	5.18	6.24	.81	.97
9	4.59	5.66	.72	.88	4.56	5.62	.71	.88
10	4.18	5.25	.65	.82	4.12	5.18	.64	.81
11	3.87	4.94	.60	.77	3.78	4.84	.59	.76
12	3.66	4.73	.57	.74	3.56	4.62	.56	.72
13	3.45	4.52	.54	.71	3.33	4.39	.52	.68
14	3.19	4.26	.50	.66	3.06	4.12	.48	.64

1/ The wage rate per man-hour is $0.156.

2/ Defined on page 5.

3/ Penning is assumed to require the same time and cost per unit volume for all tree sizes.

	Time	Cost
	Man-hours	Dollars
Per cord of 160 cu. ft. of rough wood	1.07	0.167
Per unit of 100 cu. ft. of wood only - solid volume	1.06	0.165

Trucking Pulpwood

Pulpwood production up to the point of trucking is a hand-labor process with cheap and simple tools. A saw, with handles, and an axe, at something less than $4 and $2 respectively, are the main items of expense. Other implements, such as wooden wedges, "pry-pole," oil bottle, and measuring stick, are of nominal value. Pulpwood trucking, on the contrary, demands a relatively large outlay for equipment. A new $1\frac{1}{2}$-ton truck, equipped for hauling, costs approximately $750. Ownership charges, such as interest and depreciation, and operating costs, other than labor, comprise the largest item of cost in truck operation.

Trucking of pulpwood from two operations was studied for the volume handled and for the time involved in each subdivision of the process. Information on operating expense was obtained from the contractors insofar as possible.[10/] Complete cost records for pulpwood trucks were not available. Certain items of operating expense such as tire and fuel consumption could be estimated rather accurately. Other items such as repairs could not be closely estimated in any case. It is obvious that cost of such items would vary depending upon the age of the truck, the care given it, and the type of road over which hauling takes place. In view of the incomplete state of cost data it was thought advisable to construct an operating budget based as much as possible on cost factors which were known or were susceptible of estimate. Table 9 shows a budget based on starting with a new truck purchased, as most pulpwood trucks are, on the time-payment plan. By trading-in the truck for a new one at the end of a year's use, repairs are kept at a minimum. This operating budget is based upon distance travelled for such items of expense as fuel and tires, and upon time -- i.e., a year -- for such items as wages, supervision, and insurance and capital charges. These latter items of expense are estimated to be $0.042 per mile and $1,264.00 per year ($5.06 per day for 250 days of operation).

There is ample justification for considering that hauling costs based on rough wood volume are uniform throughout the range of tree diameters. It was assumed that solid volume of pulpwood in a stack was uniform regardless of bolt size.[11/] It was found that the truck-load height tended to remain constant throughout the day's operation. As load length was fixed and load height tended to remain constant, the stacked volume of pulpwood hauled was approximately the same for any one operation irrespective of bolt or of tree diameter.

The assumption of uniform loading and unloading costs for pulpwood bolts cut from trees 5 to 14 inches in diameter is made for the purpose of the present report. Loading and unloading costs are relatively insignificant compared with hauling costs for distances as long as those of this study. The variation in the cost of loading and unloading would not greatly affect the total - see table 10.

10/ Operating cost data were obtained from two other pulpwood contractors in the locality.
11/ See page 4.

Table 9. - Operating budget[1] for $1\frac{1}{2}$-ton truck hauling pulpwood

	Per Mile	Percentage of total
I. Costs chargeable to distance travelled		
A. Current operating costs		
Gasoline (8.3 miles per gal. $20\frac{1}{4}$¢ per gal.)	$ 0.0244	58.6
Oil (444 miles per gal. - 64¢ per gal.)	0.0014	3.4
Grease and greasing	0.0009	2.2
Tires ($197.70 per set of 6 - estimated life 15,000 miles)	0.0132	31.7
Maintenance and repairs (estimated at $50.00 for 30,000 miles)	0.0017	4.1
Total operating cost per mile	$ 0.0416	100.0

	Per Year	Percentage of total
II. Costs independent of distance travelled		
A. Current operating costs		
Labor - driver's and helper's wages (250 days per year at $3 per day - total)	$750.00	59.3
Supervision (250 days per year at $0.40 per day)	100.00	7.9
Uninsured risks (5% of average investment)	25.72	2.0
Total current operating costs per year	$875.72	69.2
B. Ownership costs		
Depreciation (Purchase price less tires $556.00; Trade-in value after 1 yr. 275.00; $281.00)	$281.00	22.2
Interest 8% on down payment of $300.	24.00	1.9
Finance charges on unpaid balance of $453.70	45.37	3.6
License fee and title charge	27.25	2.2
Fire and theft insurance on unpaid balance of $453.70	10.66	0.9
Total ownership costs per year	$388.28	30.8
Total costs per year independent of distance travelled	$1,264.00	100.0
Total costs per day - 250 days	5.06	

1/ This budget is patterned in its essentials after Rapraeger, E. F. Motor truck log hauling in Oregon and Washington. Timberman 34: 12: 18-24. October, 1933.

Table 10. - Time and estimated costs of pulpwood trucking, crew of 2 men, rough wood.

	Loading		Unloading		Hauling					Hauling loading and unloading
					Based on time		Based on distance		Total hauling	
	1/ Hours	2/ Dollars	3/ Hours	2/ Dollars	5/ Hours	2/ Dollars	Miles	6/ Dollars	Dollars	Dollars
Length of haul - 12.2 mi.										
4/ Per load of 177 cu. ft. - solid volume	0.62	0.25	0.32	0.13	1.87	0.75	24.4	1.02	1.77	2.15
7/ Per cord of 160 cu. ft. - stacked volume	.40	.16	.20	.08		.49		.66	1.15	1.39
Length of haul - 26.1 mi.										
4/ Per load of 152 cu. ft. - solid volume	.42	0.15	.23	0.08	3.16	1.14	52.2	2.19	3.33	3.56
7/ Per cord of 160 cu. ft. - stacked volume	.32	.11	.17	.06		.86		1.65	2.51	2.68

		12.2 mile haul	26.1 mile haul
1/	Loading time based on two-man crews loading from pens. Number of loads	4	5
2/	Working time per day in hours	12.7	13.9
	Truck-rate per hour - based on daily rate of Table 9	$0.40	$0.36
3/	Unloading time based on two-man crews unloading into stacks 8 ft. high Number of loads -	11	11
4/	Number of loads	12	11

5/ Average time for the round trip
6/ Cost per mile for distance travelled from table 9 - $0.042.
7/ Cord of 160 cubic feet of stacked wood equivalent to 114.4 cubic feet of rough wood - solid volume.

Table 11. - Estimated trucking cost of rough wood based on the unit of 100 cubic feet of wood only - solid volume

D.b.h.	Length of haul - 12.2 miles							
	Loading 1/		Unloading 1/		Hauling 2/		Total trucking costs	
Inches	Dollars	Percent	Dollars	Percent	Dollars	Percent	Dollars	Percent
5	0.16	11	0.08	6	1.18	83	1.42	100
6	.16	11	.08	6	1.17	83	1.41	100
7	.16	11	.08	6	1.16	83	1.40	100
8	.16	11	.08	6	1.16	83	1.40	100
9	.16	12	.08	6	1.14	82	1.38	100
10	.16	12	.08	6	1.13	82	1.37	100
11	.16	12	.08	6	1.13	82	1.37	100
12	.16	12	.08	6	1.12	82	1.36	100
13	.16	12	.08	6	1.11	82	1.35	100
14	.16	12	.08	6	1.10	82	1.34	100
	Length of haul - 26.1 miles							
5	.11	4	.06	2	2.57	94	2.74	100
6	.11	4	.06	2	2.55	94	2.72	100
7	.11	4	.06	2	2.53	94	2.70	100
8	.11	4	.06	2	2.51	94	2.68	100
9	.11	4	.06	2	2.49	94	2.66	100
10	.11	4	.06	2	2.48	94	2.65	100
11	.11	4	.06	2	2.46	94	2.63	100
12	.11	4	.06	2	2.44	94	2.61	100
13	.11	4	.06	2	2.42	94	2.59	100
14	.11	4	.06	2	2.41	94	2.58	100

1/ Loading and unloading costs were assumed to be uniform for all tree diameter classes from 5 to 14 inches. The values for this table are equivalent to the corresponding ones per cord of 160 cubic feet divided by 1.144 to reduce them to 100 cubic feet of solid volume of wood and bark, and divided again by 87.9 percent - the weighted average percentage of wood volume to wood and bark volume. As 1.144 x 0.879 = 1.0056, the costs for loading and unloading shown to the nearest cent do not differ in tables 10 and 11 even though the unit of volume measure is not the same.

2/ Stacks of pulpwood from trees 5 to 14 inches in diameter are assumed to have the same volume - solid measure. If the truck loads are piled to the same height, equal amounts of rough wood volume are carried irrespective of the size of trees from which the pulpwood is cut. The amount of wood carried is then proportional to the ratios of wood to wood and bark of table 3. The percentages of table 3 were used to compute these trucking costs for each diameter class by the same method as shown in footnote 1 of this table (table 11).

The basis of truck time and output data in tables 10 and 11 is shown as follows:

Haul	(miles)	12.2	26.1
Time worked	(hours)	12.7	13.9
Trucks	(number)	3	3
Loads	(number)	12	11
Bolts	(number)	1,237	1,427
Bolts	(cu.ft.)	2,118	1,676
Bolts	(cords) 1/	18.7	14.7
Bolts per cord	(number)	66	97
Volume per bolt	(cu.ft.)	1.7	1.2

1/ of 160 cubic feet.

Data on trucking rough wood per cord of 160 cubic feet, irrespective of tree diameter, are given in table 10 and those per 100 cubic feet of solid volume of wood alone in table 11 for each tree diameter class. The assumption is made that the time and the cost of loading and unloading rough pulpwood is the same per unit volume of wood and bark.12/ The cost of loading and unloading pulpwood, based on the volume of the wood alone, is assumed to be uniform and the method of computing it is explained in footnote 1 of table 11. Hauling cost in table 11 varies for each tree diameter class. As pulpwood on a truck is piled in the same way as on the ground, the same relationship of equal amounts of solid volume for stacks of like dimensions should hold true. The load capacity of trucks hauling pulpwood was determined by the height of the load (which is proportional to stacked volume since the length of the load is fixed) rather than by the weight of the wood carried. If these two considerations are accepted, it is possible to allocate cost of hauling of rough wood on the basis of the unit of 100 cubic feet of wood without bark for each diameter class even though hauling is accepted as uniform, per unit volume of rough wood, for all tree diameters of this present study. The method of computing hauling cost for each tree diameter class on the basis of the unit of 100 cubic feet of wood alone is explained in footnote 2 of table 11.

The trucking data in tables 10 and 11 are shown separately for two hauls from the woods to the mill. The haul of 12 miles was over a woods road for about a mile and over a graded sand road in rough condition for the remainder. The haul of 26 miles was over a woods road for 12 miles and over a paved highway for the remaining 14 miles. No distinction was made in allocating the operating costs of table 9 because of the difference in hauling conditions, though it is recognized that at least two classifications are needed - one for paved and gravelled roads and one for unimproved roads.

In table 10 the load is the unit upon which time requirements of the various operations are based. Costs are shown also per cord of 160 cubic feet of rough wood. The percentage relationship of each hauling item in terms of total trucking cost is shown below:

Length of haul	12.2 miles	26.1 miles
	Percent	Percent
Loading	11	4
Unloading	6	2

12/ See page 15.

Hauling - based on time	35	32
based on distance	48	62
Total of hauling	83	94
Loading, unloading, & hauling	100	100

The importance of loading trucks to "comfortable" capacity is plain from an examination of table 10. Loading and unloading costs are about 17 and 6 percent of the total trucking cost for the 12 and the 26-mile haul respectively. The greater loading and unloading costs of the 12-mile haul are not to be understood to be due to lesser distance. The hauling costs make up the remainder. More volume per load, within reasonable carrying capacity of the truck, means lessened hauling costs per unit of volume while the loading and unloading costs remain the same. No reason other than the policy of the contractor can be assigned to the markedly smaller loads carried on the longer haul. The stretches of sand and the sharp pitches of adverse grade encountered on this haul were overcome without difficulty. In this instance, each extra cubic foot of wood carried would have helped to reduce the trucking cost. The loads on this haul had a tendency to shift and disintegrate owing to roughness of the road. It is believed that this condition could have been corrected in part, at least, by binding the load to the truck. There are a number of simple devices to obtain tension in chains, which are in common use in trucking, such as a small screw jack placed to put a "bight" in the chain after it is drawn taut by hand or the <u>load binder</u> which accomplishes the same purpose of increased tension by means of lever action. The data on trucking in this present report are too meagre to form a basis of speculation on the load size which is most economical; that is, the load size which shows the lowest cost when all operating expenses are considered. 13/

The following table, made up from the time data which were used in the preparation of tables 10 and 11, shows the time requirements for pulpwood trucking in man-hours:

Unit of measure	Haul of 12.2 miles			
	Loading	Unloading	Hauling	Total
Load of 177 cu. ft. of rough wood - solid volume	1.24	0.64	3.74	5.62
Cord of 160 cu. ft. of rough wood	.80	.41	2.42	3.63
Unit of 100 cu. ft. of wood alone for 10-inch trees - solid volume	.80	.41	2.39	3.60
	Haul of 26.1 miles			
Load of 152 cu. ft. of rough wood solid volume	0.84	0.46	6.32	7.62
Cord of 160 cu. ft. of rough wood	.64	.35	4.76	5.75
Unit of 100 cu. ft. of wood alone for 10-inch trees - solid volume	.64	.35	4.70	5.69

13/ This economical or optimum load size undoubtedly varies with type of roads.

As noted above these data are expressed in man-hours. As there were two men with each truck the numbers of man-hours per load given in the text table are twice the numbers of "truck-hours" shown in table 10. The difference in man-hour requirements per load for loading and unloading is marked. Comparison of loading and unloading time requirements should be made on the basis of the cord of 160 cubic feet of rough wood or the unit of 100 cubic feet of wood alone - solid volume. On these bases of comparison loading time is 25 percent greater for the 12-mile haul while unloading time is about 17 percent greater. It was apparent to the observers that the efficiency of the truck crews of the shorter haul was markedly lower than that of the crews of the 26-mile haul. It is possible that this factor may explain some of the difference in loading and unloading time. However, it may be seen in the text table on page 19 that the average volume per bolt for the shorter haul was 1.7 cubic feet or 41 percent greater than the average of the longer haul. On a weight basis the bolts of the shorter haul averaged 106 pounds compared with 75 pounds for the other haul. 14/ It is probable that the weight of wood handled was a ruling factor in the variation of loading and unloading time. Perhaps it had an effect upon the efficiency of the truck crews.

The man-hours required for hauling vary with many factors such as distance, hauling conditions, drivers, weight of load, and type and condition of truck. Distance and hauling conditions are no doubt the factors of most significance. If the 12-mile haul is used as a base, the 26-mile haul was 114 percent longer while the time required to travel the longer distance was but 96 percent greater. This difference can be partially explained by the better hauling conditions of the longer haul. Such factors as the others enumerated may well account for part of the difference. The solid volume of rough wood carried was 14 percent less for the 26-mile haul. The truck crews of the longer haul were faster loaders; perhaps the drivers were faster as well.

Figures 3 and 4 present the cost data of tables 10 and 11 in graphic form. The cost of cutting and penning from tables 7 and 8 is also shown. These costs for cutting and penning and for trucking are presented as a total production-cost curve (excluding the compensation for risk and for profit). In figures 3 and 4 the comparative costs of cutting and penning and of the costs of trucking are portrayed. Even with the 12-mile haul, trucking costs are the major item; with the 26-mile haul the cutting costs, compared with the total, are of relatively minor significance.

14/ Green longleaf pine pulpwood is about as heavy as water. It was observed that some bolts will float in fresh water while others sink. These weights are calculated on the assumption that pulpwood and water weigh equally per cubic foot.

FIG. 3

SALES PRICE AND PRODUCTION COST OF PULPWOOD

CLASS I FOR ROUND AND TURPENTINED LONGLEAF PINE WHERE ALL TURPENTINED BOLTS ARE TAKEN WITHOUT BEING TRIMMED.

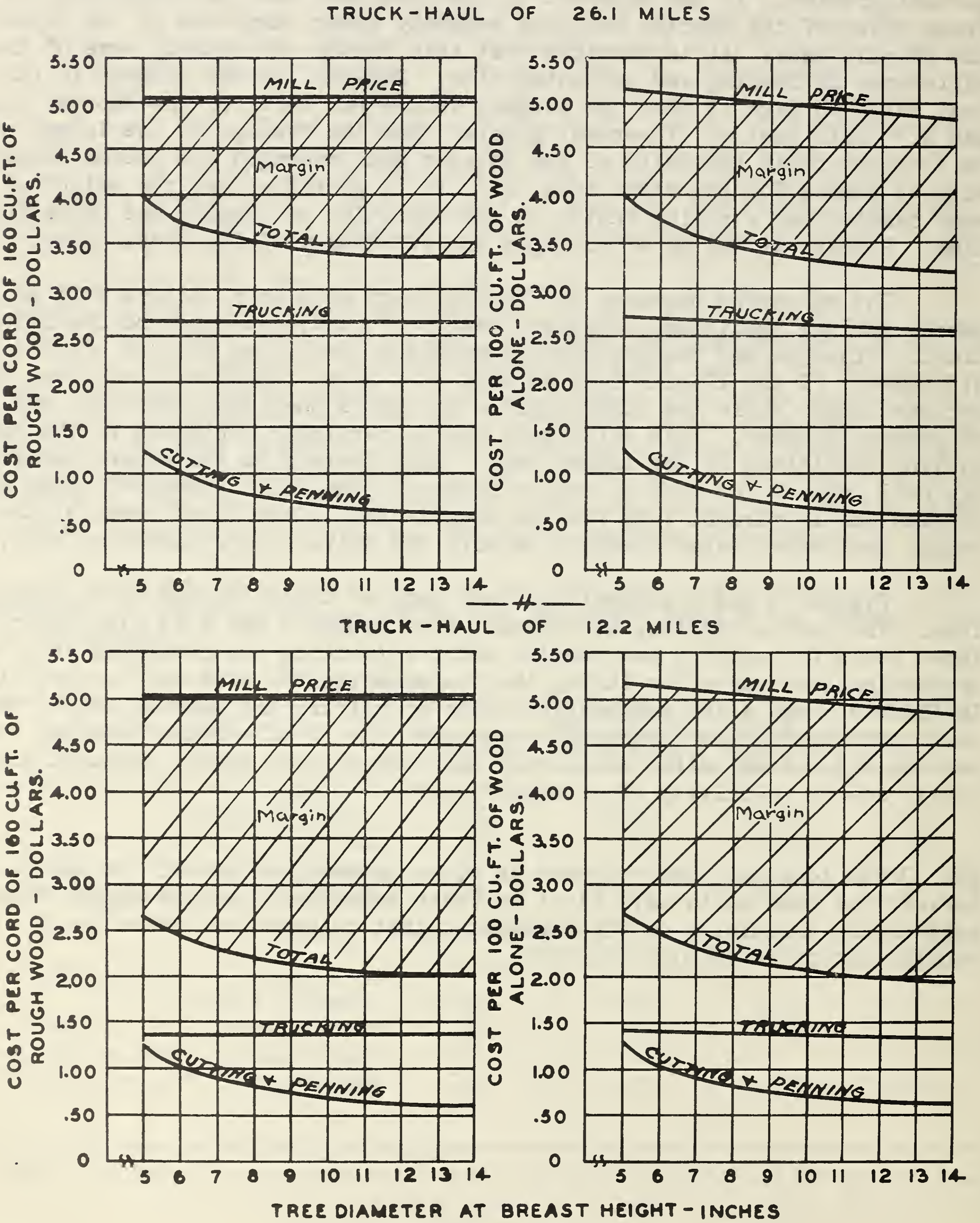


FIG. 4

SALES PRICE AND PRODUCTION COST OF PULPWOOD

CLASS II FOR TURPENTINED LONGLEAF PINE - ACTUAL CONDITIONS AS FOUND IN THE STUDY, TURPENTINED BOLTS TAKEN OR DISCARDED, TRIMMED OR NOT TRIMMED - BASED ON VOLUME ACTUALLY USED.

TRUCK-HAUL OF 26.1 MILES

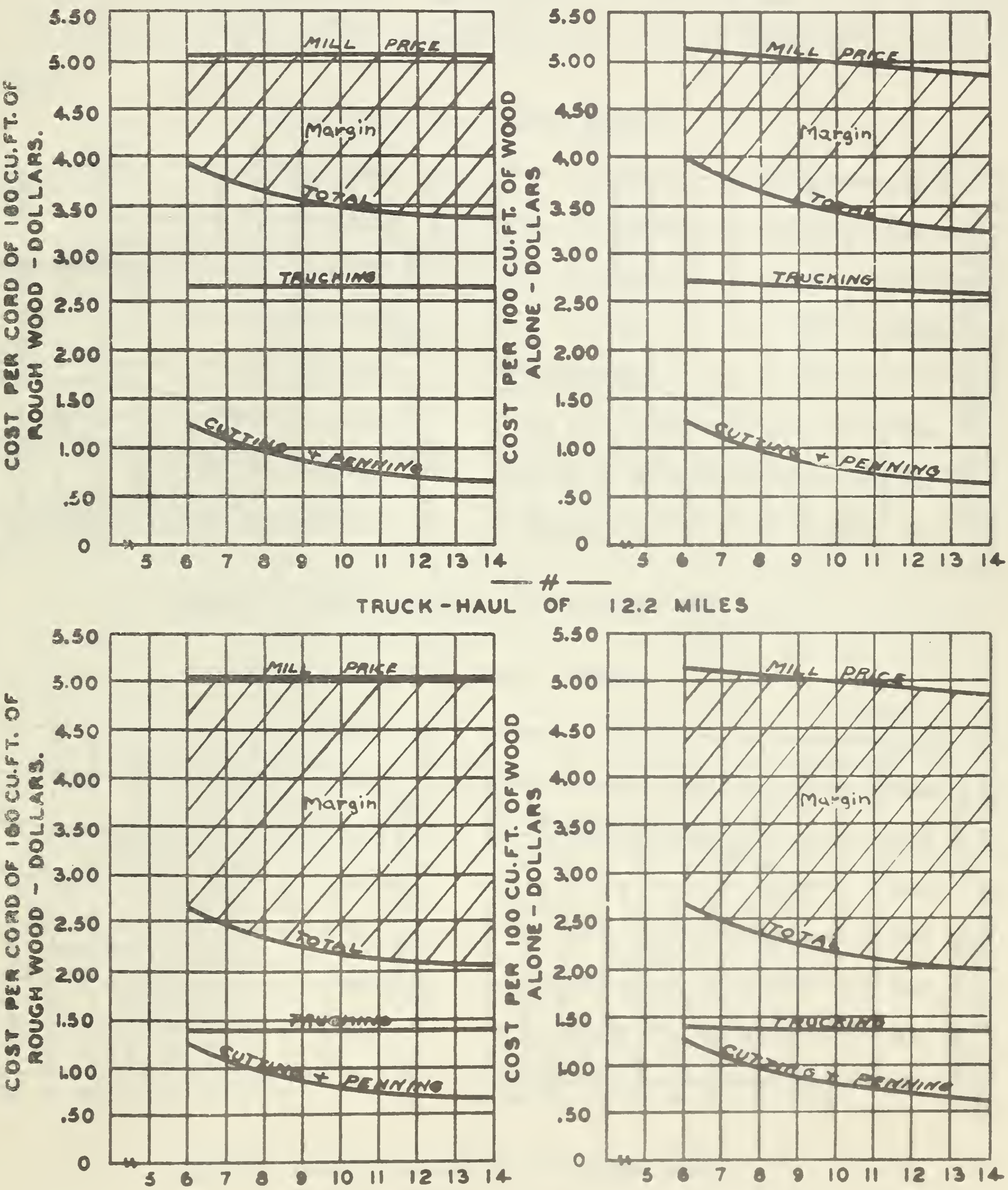
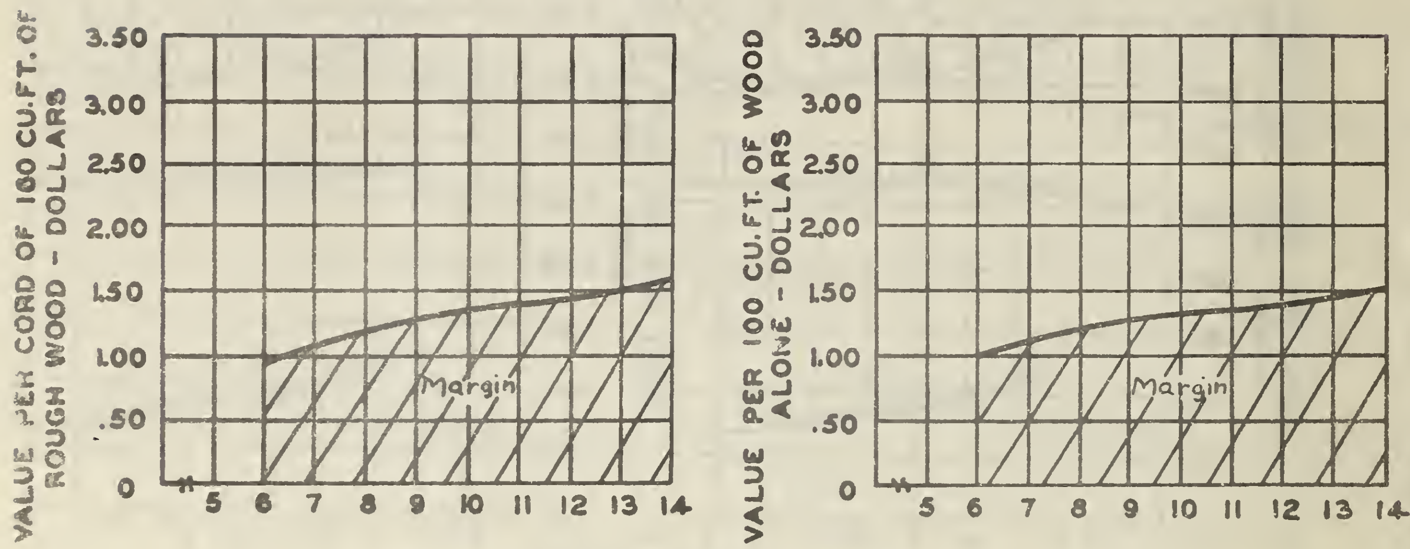


FIG. 5

MARGIN FOR RISK, PROFIT, AND STUMPAGE.

CLASS II FOR TURPENTINED LONGLEAF PINE - ACTUAL CONDITIONS AS FOUND IN THE STUDY, TURPENTINED BOLTS TAKEN OR DISCARDED, TRIMMED OR NOT TRIMMED - BASED ON VOLUME BETWEEN STUMP AND LAST CUT.

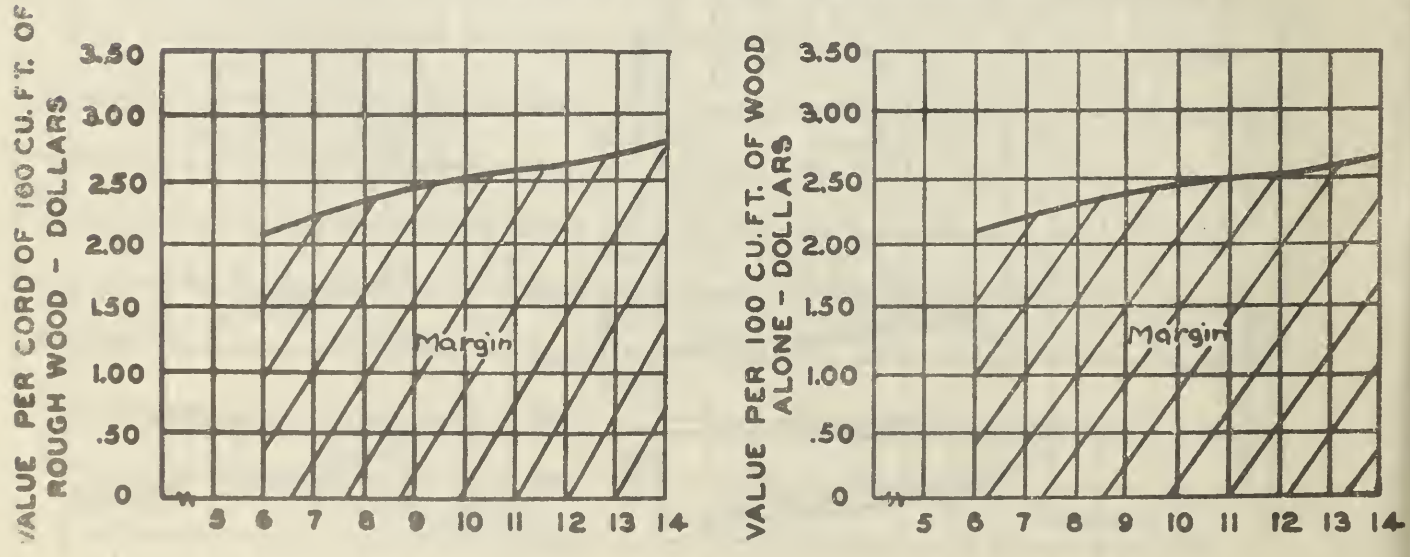
TRUCK-HAUL OF 26.1 MILES



TREE DIAMETER AT BREAST HEIGHT - INCHES

— # —

TRUCK-HAUL OF 12.2 MILES



TREE DIAMETER AT BREAST HEIGHT - INCHES

Table 12. - Estimated margin for profit, risk, and stumpage in pulpwood production per cord of 160 cubic feet of rough wood from longleaf pine

D.b.h.	For haul of 12.2 miles			For haul of 26.1 miles		
	Class I 1/	Class II 2/		Class I 1/	Class II 2/	
		Based on volume between stump and last cut	Based on volume utilized		Based on volume between stump and last cut	Based on volume utilized
Inches						
5	$2.38	-	-	$1.10	-	-
6	2.63	$2.05	$2.40	1.34	$0.95	$1.11
7	2.76	2.20	2.57	1.47	1.10	1.28
8	2.84	2.32	2.70	1.55	1.21	1.41
9	2.91	2.41	2.79	1.62	1.29	1.50
10	2.96	2.48	2.85	1.67	1.36	1.56
11	2.99	2.55	2.90	1.70	1.42	1.61
12	3.01	2.61	2.93	1.72	1.46	1.64
13	3.03	2.70	2.96	1.74	1.52	1.67
14	3.05	2.83	3.01	1.76	1.62	1.72

1/ Class I is defined on page 5.
2/ Class II is defined on page 5. The values in the first column under Class II are based on the wood and bark volume between stump and the last cut. The values in the second column under Class II are based on the volume actually used, that is the volume excluding those turpentined bolts which were discarded in pulpwood cutting. All data for cutting and hauling have been based upon the volume actually used. This is the first reference to potential pulpwood volume in the turpentined trees. From a landowner's viewpoint the values of the first column express the worth in the stand based on the volume actually present; from a pulpwood contractor's viewpoint the values of the second column express the worth of the stand based on what he might plan to cut under conditions similar to those of this study.

Sales price of pulpwood is $5.06 per cord of 160 cubic feet of rough wood - stacked volume.

Table 13. - Estimated margin for profit, risk, and stumpage in pulpwood production from longleaf pine; based on 100 cubic feet of wood without bark 1/

D.b.h.	Sales price 2/	For haul of 12.2 miles			For haul of 26.1 miles		
		Class I 3/	Class II 4/		Class I 3/	Class II 4/	
			Based on volume between stump and top	Based on volume utilized		Based on volume between stump and top	Based on volume utilized
Inches							
5	$5.18	$2.45	-	-	$1.13	-	-
6	5.14	2.68	$2.10	$2.45	1.37	$0.98	$1.14
7	5.10	2.78	2.22	2.59	1.48	1.11	1.29
8	5.07	2.84	2.32	2.70	1.56	1.22	1.42
9	5.03	2.89	2.39	2.77	1.61	1.29	1.49
10	4.99	2.91	2.44	2.81	1.63	1.33	1.53
11	4.96	2.92	2.49	2.83	1.66	1.38	1.57
12	4.92	2.91	2.53	2.84	1.66	1.42	1.59
13	4.89	2.91	2.61	2.86	1.67	1.48	1.62
14	4.85	2.91	2.70	2.87	1.67	1.53	1.63

1/ This table shows the data of table 12 on the basis of 100 cubic feet of wood without bark - solid volume.
2/ Sales price per 100 cubic feet of wood without bark when sale is made at $5.06 per cord of 160 cubic feet of rough wood - stacked volume. These values for each tree diameter class, are obtained by dividing $5.06, sales price per cord for rough wood delivered by truck by 1.144 - the converting factor from the cord of 160 cubic feet to 100 cubic feet of rough wood - solid volume; the result is then divided by the percentage of wood alone in wood and bark volume from table 3.
3/ Class I is defined on page 5.
4/ See footnote 2 of table 12.

Margin of Sales Price Above Production Cost

The average sales price of pulpwood delivered by truck to the pulpmill in this study was found to be $5.06 per cord of 160 cubic feet of rough wood stacked volume. (See left half of figures 3 and 4.) At a constant price per cord the mill pays more per cubic foot of solid volume for small-diameter wood than for large, because of the increasing percentage of bark volume in pulpwood as diameter decreases. This explains why the line labelled "mill price" slopes downward to the right in the right half of figures 3 and 4.

No compensation for risk and profit of the contractor[15/] has been provided in the production costs presented in this report. There is but slight risk inherent in an enterprise of this nature. The amount of profit to which a pulpwood contractor is entitled is uncertain. For these reasons compensation for risk and profit is retained with stumpage in a lump sum called the <u>margin of sales price above production cost.</u>

Tables 12 and 13 show the margin of sales price above production cost for two units of volume, the cord of 160 cubic feet of rough wood and the unit of 100 cubic feet of wood without bark. Footnote 2 of table 12 explains the presentation of the two columns for Class II. These margins of tables 12 and 13 appear also in figures 3, 4, and 5. Figures 3 and 4 show them in the hachured area of the graphs between the mill price and the total cost curves. Figure 5 gives the margin based on the volume between <u>stump and last cut</u> for turpentined trees.

Pulpwood stumpage is commonly bought by the contractor for a lump sum for part or all of the stand of a specific area or is bought at a fixed rate per cord. Both methods of stumpage purchase were in use in the locality of this study. When pulpwood stumpage is purchased at a pre-determined price per cord, payment is customarily made as the contractor receives his pay from the purchasing mill and the mill's measurement of volume is accepted as the basis of settlement with the landowner. Pulpwood stumpage, when bought by the cord of 160 cubic feet of rough wood-mill measurement - ranged from 50 cents to $1.25 in the area studied. Variations in price were due both to relative location of the stumpage with respect to market and to the differences in bargaining power of buyer and seller as well as to quality of the timber. It is not possible to state what price was received by the landowner when a lump sum was paid for a specific amount of standing timber as no inventory was made of the available wood on any of these tracts.

If 20 percent of production cost be accepted for the purpose of discussion as the amount of compensation for risk and profit for the contractor, the following figures indicate the hypothetical stumpage value of the trees cut for pulpwood for the two operations where trucking costs were estimated:

15/ The item of 5 percent of the average investment for uninsured risks in table 9 refers to risks peculiar to truck operation which could be cared for by taking out additional insurance.

Truck haul miles	Timber condition	Stumpage value per cord of 160 cubic feet of rough wood for each tree diameter at breast height									
		5	6	7	8	9	10	11	12	13	14
12.2	Class I 1/	$1.86	$2.14	$2.30	$2.40	$2.48	$2.54	$2.58	$2.60	$2.62	$2.65
	Class II 2/		1.60	1.77	1.91	2.02	2.10	2.17	2.23	2.31	2.44
26.1	Class I 1/	0.31	.60	.75	.85	.93	.99	1.03	1.05	1.08	1.10
	Class II 2/		.27	.45	.58	.68	.75	.81	.86	.90	.99

1/ Defined on page 5.
2/ Defined on page 5. Based on volume of rough wood between stump and last cut.

The wages recorded in this report were those current in the summer of 1934. However, with generally improved conditions wages may be increased. Such increases would directly affect stumpage values. If the piece-rate for pulpwood cutters were adjusted to enable them to earn $0.25 per hour and if truckmen were paid $0.30 per hour, the stumpage value per cord for the 12-mile haul would be a positive quantity for 7-inch trees and larger of Class I and for 8-inch trees and larger of Class II. The present mill price of $5.06 per cord precludes hauling pulpwood 26 miles under the assumed wage rates. It is estimated that the stumpage value of 13-inch trees of Class II would be minus $2.52 per cord for the 26-mile haul under these assumed wage rates The trees of smaller size would have still greater negative stumpage values.

The text table presented above shows the hypothetical stumpage values under certain specific operating conditions and under the assumption that 20 percent of production cost is a fair compensation to the contractor for risk and for profit. These values should not be confused with the cost of production of this stumpage. The costs and revenues of handling the stand have been ignored. The costs include such charges as taxes, fire protection, administration, thinnings and improvement cuttings. The revenues include such items as income from turpentining[16/] and material from thinnings and improvement cuttings and stumpage sold for such purposes as lumber, poles, piling, conduit blocks, and fuelwood. The value of stumpage which might be added by growth and financial increment (occurring through rise of the price of wood products), as well as by possible enhanced growth of the portion of the stand which is left if partial cutting is practiced, has been disregarded. For such reasons as these it is obviously impossible to indicate the size of the smallest tree profitable to handle on a forestry basis (from the viewpoint of the landowner who intends to devote the land in the future, as in the past, to the growing of forest products).

From a liquidation basis (from the viewpoint of the landowner who intends to "cash-in" on his timber and sell his land or allow it to "go" for taxes) all of the diameter classes listed in the foregoing text table show a positive stumpage value (based on the present mill price and current labor costs). If he is shrewd

16/ It should be noted that the more progressive turpentine operators do not hang cups on young trees until their diameter at breast height has reached nine inches. Table 2, column 2, shows the distribution of turpentined timber by diameter classes encountered in the present study. It is very evident that many trees were turpentined when but 5 and 6 inches in diameter.

enough to obtain these values in a sale - or an average price per unit of volume for his stand which would give him the same total price for his tract - all diameter classes from 5 to 14 inches should be included.

Analysis of Pulpwood Production Costs

A further analysis and grouping of the various items of cost in pulpwood production are included in the present report so that the present system may be better understood and possible ways of improvement suggested. Figure 2 shows the operation of pulpwood cutting under the following 4 parts: felling, limbing, bucking, and penning. The relative importance of these items for specified tree diameter classes is shown in table 14.

It can be seen in table 14 that the share of time and cost of cutting and penning chargeable[17/] to felling and limbing is relatively small except in the small tree diameter-classes. The major portion is chargeable to bucking (to trimming of fire scarred turpentined bolts for Class II timber) and to penning. For example, in the 9-inch tree class, 22 percent for round trees and 23 percent for turpentined trees represent the portion of time and cost charged to felling and limbing, while the remainder, 78 and 77 percent respectively, is borne by the other pulpwood cutting operations. Between one-eighth and one-quarter of all cutting time and cost is attributable to penning. Pens (1) form the basis of payment for work performed; (2) serve as concentration points which decrease loading cost; (3) aid in reducing the amount of insect and fungus infestation through more rapid drying of pulpwood bolts; and (4) should serve to decrease hauling cost by the lessened weight of the partially dried wood per unit volume. It is not doubted that where factors (3) and (4) are regarded as unimportant, ways would be found to pay cutters on some other basis. Payment by the tree or by the individual bolt, regardless of size, ought to be satisfactory. The ease of tallying the output would not exist, however, under the bases proposed. It is obvious that loading pulpwood trucks from pens is faster than loading bolts as they lie on the ground after bucking. It is not known which method gives the lower total production cost under average conditions although it is believed that allowing bolts to remain on the ground until loading takes place is cheaper. Footnote 2 of table 10 shows the hourly truck rate for the 12 mile haul to be $0.40 and for the 26 mile haul to be $0.36. The additional truck cost occasioned by loading bolts from their dispersed

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17/ The assumption is made, which is by no means substantiated by observation, that all of these items of pulpwood cutting are equally laborious. It would appear that penning is the most tiring; bucking perhaps takes second place; with felling third; while trimming and limbing are the least exhausting of all.

Table 14. - Ratio of pulpwood cost items to the total cost, by tree diameter classes

Class I.[1/] Pulpwood Timber

D.b.h.	Felling	Limbing	Felling & limbing	Bucking	Penning	Bucking & penning	Total of all cutting 2/		
(inches)	- - -	- - -	- - -	Percent	- - -	- - -	Dollars	Man-hours	Percent
5	26	15	41	46	13	59	1.28	8.24	100
7	16	10	26	56	18	74	.91	5.84	100
9	13	9	22	56	18	78	.76	4.89	100
11	12	9	21	54	25	79	.68	4.37	100
13	12	9	21	53	26	79	.64	4.12	100

1/ Defined on page 5.
2/ Per cord of 160 cubic feet of rough wood.

Class II.[1/] Pulpwood Timber

D.b.h.	Felling	Limbing	Felling & limbing	Bucking	Trimming turpentined bolts	Penning	Bucking, trimming & penning 2/	Total of all cutting 3/		
(inches)	- - -	- - -	- - -	- - -	Percent	- - -	- - -	Dollars	Man-hours	Percent
7	15	9	24	55	5	16	76	1.10	7.05	100
9	13	10	23	55	3	19	77	.88	5.66	100
11	12	10	22	54	2	22	78	.77	4.94	100
13	12	9	21	53	2	24	79	.71	4.52	100

1/ Defined on page 5.
2/ In the present investigation with seven of the eight crews studied, the decision whether to trim the turpentined bolt and include it in the output or to reject it, if unacceptable without treatment, rested with the cutters - see page 7. In the present report the time devoted to trimming of bolts rank as an unimportant item of total cutting and penning cost. This condition does not always exist. In another investigation, not yet reported, in similar timber where the landowner specified that all wood between a low stump and the top should be marketed, a sample of two days' cuttings of two-faced turpentined trees shows between 30 and 35 percent of cutting and penning time was spent reclaiming the fire-damaged portion of the turpentined bolts.
3/ Per cord of 160 cubic feet of rough wood based on volume actually used.

locations on the ground would have to be balanced against the man-hour rate for pulpwood cutters of $0.156 and the time required for the operation.18/

It is shown in table 14 that for trees of the 7-inch diameter class and larger at least 70 percent of the cutters' time (and probably more than that proportion of his energy) is consumed in the items of bucking and penning. Bucking need not be done by hand-labor; it can be carried on with the proper power equipment in a suitable location. Penning is mainly a concentration process which should be efficiently performed with draught animals if the pulpwood were left in tree-lengths.

The data in tables 15 and 16 are presented to show for specified tree-diameter classes the relative importance of each item of production cost in terms of the total. It was shown on page 12 that pulpwood cutting is a hand-labor process where payment for labor comprises 83 percent of the cutting cost to the contractor. The remainder is spent by the cutters for tools and tool maintenance and by the contractor for supervision. In pulpwood truck operations one-third to one-fifth is spent for labor depending upon the length of haul. It is quite obvious that increase in pulpwood wages without accompanying increase in other items of cost would markedly increase cutting cost while trucking cost would not be so greatly affected. Thus it is well to give attention, if changes in methods are contemplated, to improvements which will require a smaller proportion of labor expense in relation to expenditures for equipment investment, maintenance and operation cost.

18/ Contractors would probably not make calculations of this type for their own work. It was stated (see page 6) that there is a difference between pulpwood cutting and transportation in method of payment. Usually cutting is paid for by a fixed piece-rate while trucking is performed by labor paid by the day working with trucks owned and operated by the contractor (or subcontractor). The contractor carefully watches for opportunities to reduce his transportation costs as lower costs in this department work to his immediate advantage. Cutting is "farmed-out" to individual cutting crews at a rather inflexible contract rate (for example, 20 cents per pen) and the contractor is loath to change a piece-rate once it is established. It is possible, however, to demand more in the form of additional labor for the same piece-rate in such instances as working less desirable timber or trimming a greater portion of fire-scarred turpentined bolts. To impose tasks or to assign timber for cutting which require 20 percent more time per unit of output is not resented as much as the equivalent reduction of 17 percent in the piece-rate. One does not readily think of units of measure as shifting but a change in price per unit volume is easily perceived.

While careful weighing of the cost of pulpwood production is quite possible the contractor is usually content to strive to reduce his transportation charges by penning even though the total production cost may be higher because of the expense to him (ultimately) of paying for penning.

Table 15. - Ratio of items of production cost per cord of 160 cubic feet of rough wood to total cost, by tree diameter-classes

Class I.[1] Pulpwood Timber

D.b.h. (Inches)	Felling & limbing	Bucking & penning	All cutting	Loading and Unloading	Hauling	All trucking	Total of cutting and trucking	
	Length of truck haul - 12.2 miles - truckmen $0.118 per hour							
	Percent						Dollars	Percent
5	20	28	48	9	43	52	2.67	100
7	10	30	40	10	50	60	2.30	100
9	8	27	35	11	54	65	2.15	100
11	7	26	33	12	55	67	2.07	100
13	6	25	31	12	57	69	2.03	100
	Length of truck haul - 26.1 miles - truckmen $0.108 per hour							
5	13	19	32	4	64	68	3.96	100
7	6	19	25	5	70	75	3.59	100
9	5	17	22	5	73	78	3.44	100
11	4	16	20	5	75	80	3.36	100
13	4	15	19	5	76	81	3.32	100

Table 16. - Ratio of items of production cost per cord of 160 cubic feet of rough wood to total cost, by tree diameter-classes

Class II.[1] Pulpwood Timber

D.b.h. (Inches)	Felling & limbing	Bucking, trimming and penning	All cutting	Loading and Unloading	Hauling	All truck-	Total of cutting and trucking	
	Length of truck haul - 12.2 miles - truckmen - $0.118 per hour							
	Percent						Dollars	Percent
7	11	33	44	10	46	56	2.49	100
9	9	30	39	10	51	61	2.28	100
11	8	28	36	11	53	64	2.16	100
13	7	27	34	11	55	66	2.10	100
	Length of truck haul - 26.1 miles - truckmen - $0.108 per hour							
7	7	22	29	4	67	71	3.78	100
9	6	19	25	5	70	75	3.57	100
11	4	18	22	5	73	78	3.45	100
13	4	17	21	5	74	79	3.39	100

1/ Defined on page 5.

Competition of Pulp Industry With Pole Industry

Pole treating plants, to a certain extent, compete with pulpmills for raw material in the naval stores region. Any small pine tree is usually potential pulpwood timber; the demands of the pole treating plants are more exacting. For 10 million acres in southeastern Georgia, the Forest Survey, a project of the Southern Forest Experiment Station, estimated that 18 percent of the standing pines from 8 to 14 inches in diameter are potential pole material.

A questionnaire was sent to pole treating plants throughout the South in October 1936, asking for current pole prices by lengths and the American Standards Association classes. A summary of the 11 replies received is shown in table 17. Table 18 shows the corresponding values per 100 cubic feet of peeled wood, solid volume. It should be noted that these prices are f.o.b. cars at the loading point.

Table 17. - Prices for peeled pine poles f.o.b. cars at the loading point[1/]

Pole length (feet)	American Standards Association Classes									
	1	2	3	4	5	6	7	8 [2/]	9	10
	Dollars per pole									
16					0.42	0.34	0.30		0.29	0.24
18			0.59	0.58	.49	.40	.36		.32	.27
20	0.98	0.90	0.70	.66	.56	.46	.42		.36	.30
25	1.45	1.30	1.08	.90	.78	.65	.58		.50	.45
30	2.04	1.83	1.53	1.23	1.08	.93	.81		.72	
35	2.76	2.45	2.14	1.68	1.47	1.33	1.12			
40	3.64	3.20	2.84	2.32	2.04	1.80	1.52			
45	4.68	4.10	3.69	3.15	2.74	2.43	2.02			
50	5.95	5.20	4.80	4.20	3.70	3.30	2.70			
55	7.42	6.44	6.05	5.50	4.84	4.46				
60	9.06	7.92	7.44	7.02	6.18	5.88				
65	10.92	9.62	9.10	8.84	7.80					
70	12.95	11.55	10.92	10.92	9.59					
75	15.30	13.88	12.98	13.20						
80	18.00	16.56	15.28							
85	21.25	19.64	17.94							
90	26.10	23.49	21.06							

1/ Based on 11 replies to a questionnaire sent to pole treating plants in the South.
2/ Prices for class 8 are not shown; data insufficient.

Table 18. Prices for peeled pine poles per 100 cubic feet - solid volume - f.o.b. cars at the loading point

Pole length (feet)	American Standards Association Classes									
	1	2	3	4	5	6	7	8 1/	9	10
	Dollars per 100 cubic feet									
16					9.90	9.33	10.13		11.52	12.00
18			8.61	9.76	9.72	9.43	10.59		11.57	11.25
20	7.60	8.74	8.24	9.30	9.33	9.02	9.77		10.00	10.34
25	8.06	8.34	8.74	8.65	8.71	8.55	9.13		9.62	10.71
30	8.79	9.34	9.16	8.66	9.00	9.30	9.76		10.75	
35	9.70	10.04	10.17	9.23	9.42	9.85	9.57			
40	10.61	10.85	11.14	10.50	10.63	10.71	10.41			
45	11.58	11.80	12.22	11.98	11.88	11.97	11.38			
50	12.66	12.94	13.71	13.73	13.65	13.69	12.68			
55	13.72	13.81	15.13	15.67	15.46	15.69				
60	14.43	14.80	16.32	17.64	17.41	17.98				
65	14.96	15.82	17.81	19.82	19.21					
70	15.42	16.81	19.12	22.02	21.22					
75	16.19	18.02	20.34	24.04						
80	16.89	19.23	21.64							
85	17.71	20.50	22.96							
90	19.25	21.99	24.49							

1/ Prices for class 8 are not shown; data insufficient.

Table 19. - Value of trees in table 1 by diameter classes which are suitable for poles

D.b.h.	Pole Class	Pole Length	Price 1/ per pole	Price per 2/ 100 cubic feet
Inches		Feet		
6	10	20	$0.30	$10.34
7	10	25	.45	10.71
8	9	25	.50	9.62
9	7	25	.58	9.13
10	7	35	1.12	9.57
11	7	40	1.52	10.41
12	7	45	2.02	11.38
13	6	40	1.80	10.71
14	5	45	2.74	11.88

1/ From table 17.
2/ From table 18.

The average used length and top diameter outside the bark is shown in table 1 for each 1-inch diameter class of the trees studied in this project. An estimate has been made of the class and length of pole which could be cut from trees of each diameter class if it were potential pole stock. This information is presented in table 19. The specifications and dimensions of the American Standards Association have been followed in making the estimates.

The prices per pole and per 100 cubic feet shown in table 19 for each diameter are prices f.o.b. cars at the loading point. Probably $1.00 per 100 cubic feet should be added to place the prices on the same basis as the mill price data for pulpwood shown in table 13, column 2. Timber is not so completely utilized for poles as when pulpwood is cut. However, pulpwood can be cut from the discarded butt of the pole tree and from the top providing this can be done at a profit.

The information is not at hand to estimate the production cost of poles for the various classes and lengths similar to that made for pulpwood in this report. Probably there is a wide variation in cost for the different sizes in the same operation.

IV. THE POSITION OF PULPWOOD AMONG THE FOREST PRODUCTS OF THE NAVAL STORES REGION

The naval stores region[19/] east of the Mississippi River covers a total land area of 50 million[20/] acres of which slightly more than 36 million acres, 72 percent, is classed as productive forest land. Table 20 presents data showing production[21/] of certain forest products in 1934 with an estimate of the value based on 1936 prices. According to these data the gross income from sale of naval stores, about 27 million dollars, is 49 percent of the total income from the forest products listed. Pine lumber[22/] production ranks second with an estimated value of 44 percent of the total. The other items listed; namely, pulpwood, poles and piling and railroad ties are of lesser importance, ranking in the order named. The value of pulpwood is 3 percent of the total and about equals the value of the other minor products.

These volumes and gross values of finished forest products do not answer the question of the relative ranking of forest products in terms of income to the landowner in the form of stumpage. The latter part of table 20 shows the relative stumpage income. From the total estimated stumpage income in 1934 of about 12 million dollars, lumber leads with 6 million dollars (50 percent), naval stores is second with 5-1/3 million dollars (44 percent), pulpwood a poor third with 1/3 million dollars, (3 percent), while poles and piling and ties account for a little less than 1/2 million dollars between them (2 and 1 percent of the total respectively). This estimate of 12 million dollars stumpage income for the naval stores region is at the rate of $0.34 per acre.

19/ See map figure No. 6.
20/ See page 2 "Statistics on Gum Naval Stores Production," Forest Survey Release No. 17, Southern Forest Experiment Station, December 31, 1935.
21/ From unpublished Forest Survey data.
22/ Production of cypress and hardwood lumber is not included.

Table 20. - Current volume and value of forest products of the active naval stores region

Forest product	Unit of Measure	Production in 1934	1936 price per unit	Value of 1934 production using 1936 unit price	Proportion of total value	Estimated stumpage value 5/	Proportion of total estimated stumpage
					Percent		Percent
Naval stores	Unit 1/	3/ 535,161	4/ $49.85	$26,677,776	49	$5,335,555	44
Pine lumber	M. bd.ft.	1,039,340	23.00	23,904,820	44	5,976,205	50
Pulpwood	Cord 2/	437,000	4.00	1,748,000	3	349,600	3
Poles and piling	Lineal feet	17,989,000	.05	899,450	2	269,835	2
Ties	Piece	2,008,000	.40	803,200	2	160,640	1
				$54,033,246	100	$12,091,835	100

1/ 1 barrel (50-gallon) of turpentine and 3 1/3 barrels of rosin.
2/ Standard cord (128 cu.ft.).
3/ For naval stores season 1934-1935 (year ending March 31, 1935).
4/ Season average price April-September, 1936, inclusive.
5/ Based on: 20 percent of 1936 price for naval stores
25 percent of 1936 price for lumber
20 percent of 1936 price for pulpwood
30 percent of 1936 price for poles and piling
20 percent of 1936 price for ties.

Such income[23] for an area made up largely of second-growth pine under present unmanaged conditions implies relatively good returns for well-managed tracts and better income for the whole area whenever common-sense management measures are more generally adopted.

Such management would provide for the following:

(1) Fire control to assure natural reproduction and to prevent injury to reproduction, saplings and turpentined trees.

(2) Building up of understocked stands by holding the cut below the growth and especially building up the larger diameter classes so that as much as possible of productivity of the site is devoted to growth of merchantable trees.

(3) Light and frequent cutting in order to shift growth from trees of poor form and vigor to better trees.

(4) Holding the better quality trees until financially mature for turpentining, sawtimber or other use.

(5) Utilization of each portion of the tree and of each tree for its highest value in order to net the greatest profit.

The production of pulpwood in the naval stores region in 1936 will greatly exceed that recorded for 1934. Pole and piling production will also be greater. It is reasonable to believe that pulpwood in the future will rank higher with respect to lumber and naval stores than at present. It is unlikely that the supremacy of the latter will ever be seriously challenged by pulpwood. Figure 1 (page 2) indicates a subordinate place for pulpwood in most schemes of management of pine stands in the naval stores region. Only a serious disruption of the present balance of prices of timber, naval stores, pulpwood, ties and poles and piling will bring about a coordinate position for pulpwood with the 2 major forest products of this region.

The map in figure 6 points to one issue which concerns treating plant men mainly but is of obvious concern also to sawmill and naval stores operators. It is noted that pulpmills are often being built in the vicinity of established treating plants. In this area, due to unstable conditions of forest ownership and to the desire to "cash-in" on present pine stands, much of the pulpwood is produced by clear cutting, usually in timber which has been worked for naval stores, but occasionally in timber which has never been cupped. Wholesale cutting for pulpwood means that potential pole-timber and potential saw-timber are going into pulpwood without full consideration of the best interests of the landowner and of the community at large.

There is much to be said in explanation of the present situation in regard to pulpwood cutting. A pulpmill is built with capital from outside the region, operated by men usually unfamiliar with woods conditions, and run to capacity because of a favorable combination of low stumpage and cheap woods labor. Technical advances in the last 2 decades have made possible the use of southern pine for pulp and the first mills in a given territory usually reap good profits.

From the forest landowner's standpoint the coming of a pulpwood market is very advantageous. Raw material for which there has been no previous demand becomes salable. Of course sawtimber continues in demand and the pole men continue to hunt the choicest trees for treating plants. Much timber is too small for sawlogs (even with the low standards prevailing for portable mills) and the

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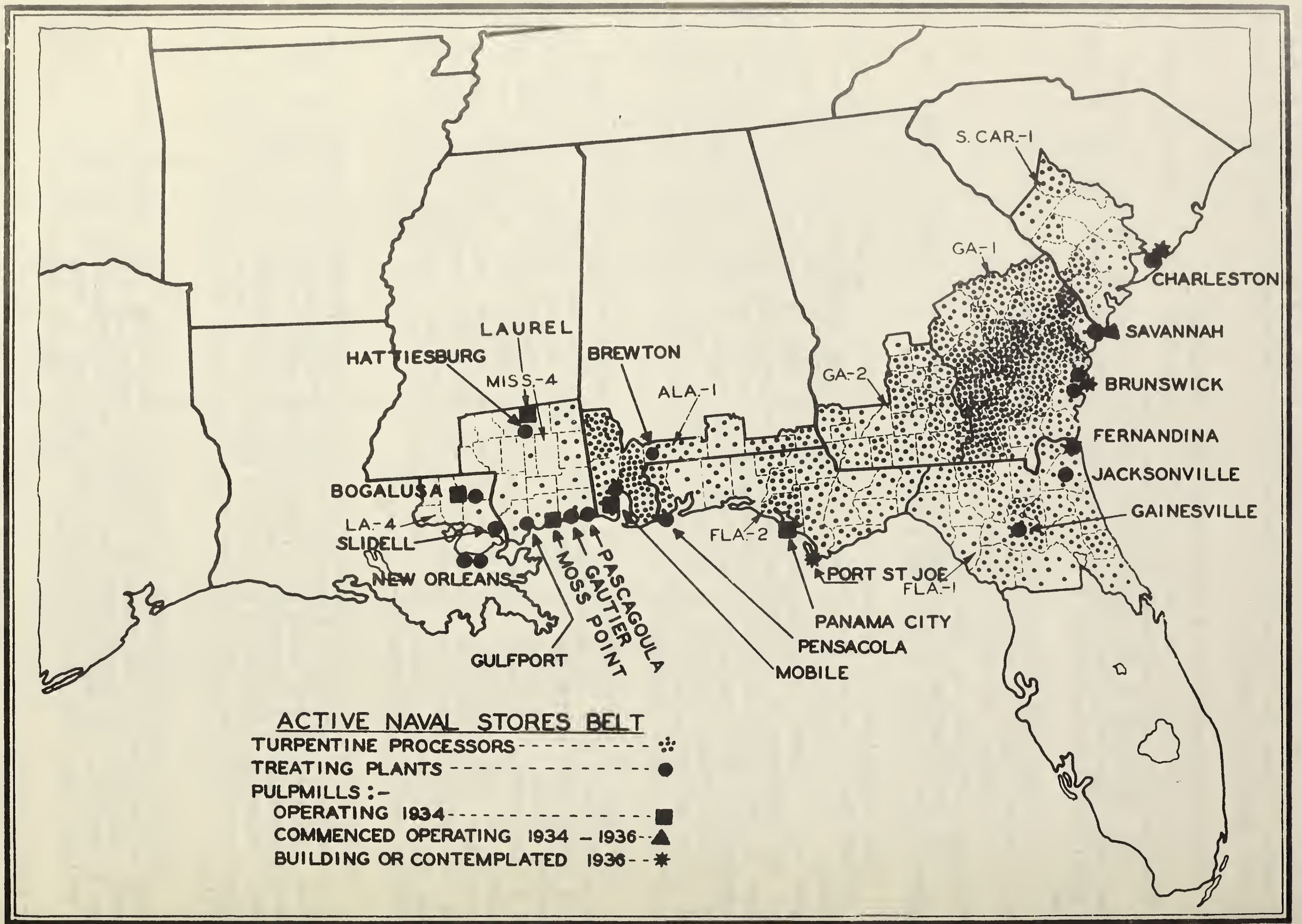
23/ If the higher value stumpage is being removed faster than it is growing, an unknown amount of this "income" must be regarded as a charge against the investment.



SOUTHERN FOREST EXPERIMENT STATION–NEW ORLEANS. LA.

FIG. 6

treating plant demands are noted for their sporadic character.[24/]

Pulpmills supply a commodity uniform in character whose demand is fairly steady. Pulpmills, for low costs, must operate continuously and to "comfortable capacity." They therefore demand a relatively steady supply of raw material. This condition in turn enables a pulpwood contractor to build up an organization gauged to maintain a stable output. The pulpmill usually divides its raw material territory between contractors so the landowner can deal with but one buyer for his stumpage. The owner either sells to him or not at all. The contractor is mainly interested in taking as much wood as possible from a given tract, either in turn for a lump sum for the whole area or for an agreed price per cord based on the volume delivered to the mill. Cutting restrictions would hamper the contractor and seem unconsequential to a landowner who usually has his timber because of the bounty of Nature.

Even if data were available to the landowner as to how best to handle his timber land to obtain the largest returns over the ensuing generation, a steady moderate income does not have the appeal of a larger amount offered in a lump sum. It is reasonable to believe that measures to conserve timber and promote continuous forest production will come from the users of forest materials rather than from the landowners. The stake of the pulp plant owner in continuous forest production is large.

V. SUGGESTED CHANGES IN PULPWOOD PRODUCTION METHODS

Various ingenious schemes have been proposed to save pole-timber from the pulpwood contractor. Many have merit but they all necessitate foresight, patience, technical organization, and ready capital on the part of the treating plant owner, landowner, or pole contractor. More resources are demanded than there is much possibility of supplying. The schemes suggest such measures as "storing on the stump" [25/] meaning the outright purchase by the treating plant operator of a pole supply for a number of years ahead. It has also been suggested that the pole man secure options on potential pole stock. This plan has merit but landowners prefer a lump sum of lesser size now than a greater sum in the future. A stumpage price of $1 a cord for pulpwood in 2 months time is greatly preferred over a $0.20 a cord option now with the prospect of final sale several years hence at $2, $3, or even $4.

Another plan is proposed here. This plan would call for a new type of logging contractor. He would replace the pole-man, the pulpwood man and possibly the portable mill man. He would have to be a business man to a far greater degree than his predecessors. He would need more equipment, more working capital, and an organized personnel of greater capabilities than heretofore.

24/ Treating plant men claim that they cannot operate steadily because of the indefinite character of their orders from power, telephone and telegraph companies. They say that they are given a fair idea of the number of poles for an ensuing year in their contracts but they have no knowledge of the lengths and American Standards Association classes which will be ordered during the contract period. A state construction and maintenance superintendent of a large telephone company in reply to the question of why pole demands could not be specified by lengths and sizes stated that in his opinion they could be within a reasonable margin of error but that the purchasing organization did not ask for data of this nature.

25/ Lemieux, Frank J. "Forestry in Southern Pines Is Here to Stay" page 98 k, vol. 153, No. 1937, Southern Lumberman, December 15, 1936.

Under the proposed plan the pulpmill procedure would not be changed. The mill would continue, as at present, to need cheap wood with delivery guaranteed. The mill would continue to buy its wood in cordwood lengths of 4 to 5 feet. Treating plant procedure would be changed because it could no longer operate at the convenience of the power, telephone and telegraph companies. Its customers would be required more nearly to make up their year's requirements at the beginning of the contract period so that the treating plants might pass on the orders to the new type contractor by pole-classes and lengths. Of course stabilized production in the treating business and stabilized work in pole production would have the effect of producing treated poles at less cost.

The Plan in Brief

Under the proposed plan, the logging contractor would arrange contracts with the pulpmill, the nearby treating plant, and local saw-mills (unless he is a saw-mill operator himself). Next he would contract with landowners to remove all or a designated part of the timber on certain parts of their holdings. The plan would work equally well under clean or partial cuttings, a matter to be determined by the forest owner.

The heart of the contractor's operating set-up would be his concentration or cut-up plant to which he would bring the logs in tree lengths. 26/ By means of mechanical devices, all of which are in use in wood utilization plants in the South, the tree-length sticks can be moved about, sorted and cut into the products which will bring the greatest income to the plant operator. The important individual in this plant is the man who sizes up each tree-length and decides how it should be cut. He will be called the "marker" in this discussion; quite properly he might operate some of the machinery. Specifically the proposed cut-up plant may be built up from a well-designed combination of a "Starr" unloader, a reversible conveyor with power "niggers" at convenient stations to divert the different products from the conveyor trough to other conveyors or to storage. A power cut-off saw, perhaps a circular saw of the swinging type, would work satisfactorily. A central plant would furnish power to operate the unloader, conveyors, "niggers" and cut-off saw. The marker could readily control the operation of the main conveyor and the cut-off saw.

The logging contractor would carefully weigh his available markets and the prices therein; he would have to make the most of his purchased raw material. Possibly if there were trees of the required dimensions a small saw-mill of his own would be advisable to work in conjunction with his plant. Perhaps he could induce some small saw-mill operator to locate with him or he might make arrangements to ship his logs to an established sawmill in the vicinity. In certain localities conduit blocks or slack stave blocks might bring better prices than pulpwood.

26/ A cut-up plant handling tree-length timber has been in operation at the Superior Pine Products Company of Fargo, Georgia. Poles, logs, conduit blocks and pulpwood were cut from the timber.

The essence of this plan is careful inspection and selection of the run-of-the-woods timber. Conceivably the marker might wander about in the woods and pass judgment on each tree as it stands or as it lies after felling. Perhaps in some cases this is the better course. However, there is no opportunity under such a system to rid the operation of its more complex character. Pulpwood would have to be bucked into 4-5 foot lengths by hand labor as heretofore. Poles and logs would occur in lengths from 12 to 60 or 70 feet. It is obvious that pulpwood trucks, log trucks and pole trucks would have to be provided and they are not readily interchangeable. Pulpwood would require loading by hand as at present. If the tree lengths were brought to a central point intact, equipment might be standardized at a minimum and supervision could be correspondingly reduced. It is obvious that passing the tree-lengths one-by-one past a marker who also operates the cut-up machinery would insure the opportunity for the maximum of scrutiny for possible enhanced returns from proper sub division of the tree-lengths. Hand labor could be reduced to a minimum and probably production costs would be materially lowered.

The major part of woods production cost lies in the transportation element. Under the ststem proposed, hand labor would be confined to felling, limbing and making the top-cut of the timber to be removed from the stand. Where the forest is accessible to trucks with a minimum of road building - typical of the naval stores region - the bunching of truck loads of timber could be done for relatively short distances with teams or light tractors. Loading may be done with a number of devices ranging in order of investment from the customary cross-haul with teams to truck-or tractor-mounted swinging booms of the dragline type. Trucks and trailers hauling tree-lengths as long as 70 feet are at present successfully operating in the naval stores region. It is evident that the selection of equipment is a matter for the contractor who has all factors to consider in making his choice.

VI. SUMMARY

The following conclusions can be drawn from this investigation of pulpwood production in the naval stores region:

1. The contract system of production was employed. The woods requirements of the mill were supplied by a selected and limited number of contractors. Each of these directly supervised production or sublet a portion or all of his quota to lesser contractors. The cutting and penning of pulpwood was done by piece-work. Trucking was usually performed by day labor.

2. A maximum of hand labor was used in production. Time of cutting and penning decreased per unit of volume with increase of tree size. Round trees 5 inches in diameter required 8.24 man-hours per cord of 160 cubic feet of rough wood compared with 3.99 man-hours for trees 14 inches in diameter. By applying the average hourly wage to these man-hour requirements the cost including supervision was $1.28 compared with $0.62. These data were based on the average output and average earnings of eight pairs of cutters. Corresponding values for worked-out turpentined trees were slightly higher.

3. The earnings of pulpwood cutters averaged $0.13 per hour. On an hourly basis the wages of truck men averaged slightly less.

4. The major share of pulpwood production costs was incurred in transportation. Under certain assumptions the transportation costs was about the same for pulpwood from trees of all sizes. For one operation with a 12-mile truck haul to the mill, transportation charges were $1.39 per cord of 160 cubic feet or 52 percent of production cost for round trees 5 inches in diameter and 69 percent for trees 14 inches in diameter. For another operation with a 26-mile haul, transportation charges were $2.15 per cord of 160 cubic feet of rough wood or 68 and 81 percent for trees of 5 and 14 inches, respectively.

5. The mill price for pulpwood was $5.06 per cord of 160 cubic feet of rough wood. The margin for profit, risk and stumpage was $2.38 per cord for round trees 5 inches in diameter and $3.05 for 14-inch trees for the 12-mile haul; for the 26 mile haul corresponding values were $1.10 and $1.76.

6. In the naval stores region, lumber and naval stores are the major forest products and are likely to continue so. Pulpwood cutting is causing concern among pole men for their future supply of timber.

7. It is possible that a portion of the raw material now being cut into pulpwood could be used more advantageously for poles or other products. A plan is proposed which would permit the utilization of all portions of each tree to the best advantage.

PLATE I

PULPWOOD PRODUCTION

A. Turpentined stand of longleaf pine after being cut for pulpwood. The timber was cupped when 5-7 inches in diameter. Cupped trees and also uncupped trees to a small diameter limit were removed. (F.S. Neg. 303892.)

B. Pulpwood cutting in 60-year old longleaf pine. Only trees worked out for turpentine have been cut. The residual stand is left for further growth and eventual turpentining. Note the pens of pulpwood. (F.S. Neg. 303883.)

C. Before the pulpwood was cut the area in this picture was covered by a stand of shortleaf and loblolly pine; the ownership boundary is marked by the line of cutting. One side is clear cut and the other left untouched. (F.S. Neg. 204762.)

D. Pulpwood cutters in the naval stores region. Both white and colored men work at pulpwood cutting. (F.S. Neg. 303874.)

E. Most kraft paper mills accept turpentined butts if all charred wood and metal have been removed. Some landowners require that all these butts be salvaged. If fire has not charred the turpentined faces only ingrown bark and nails need be removed. (F.S. Neg. 303881.)

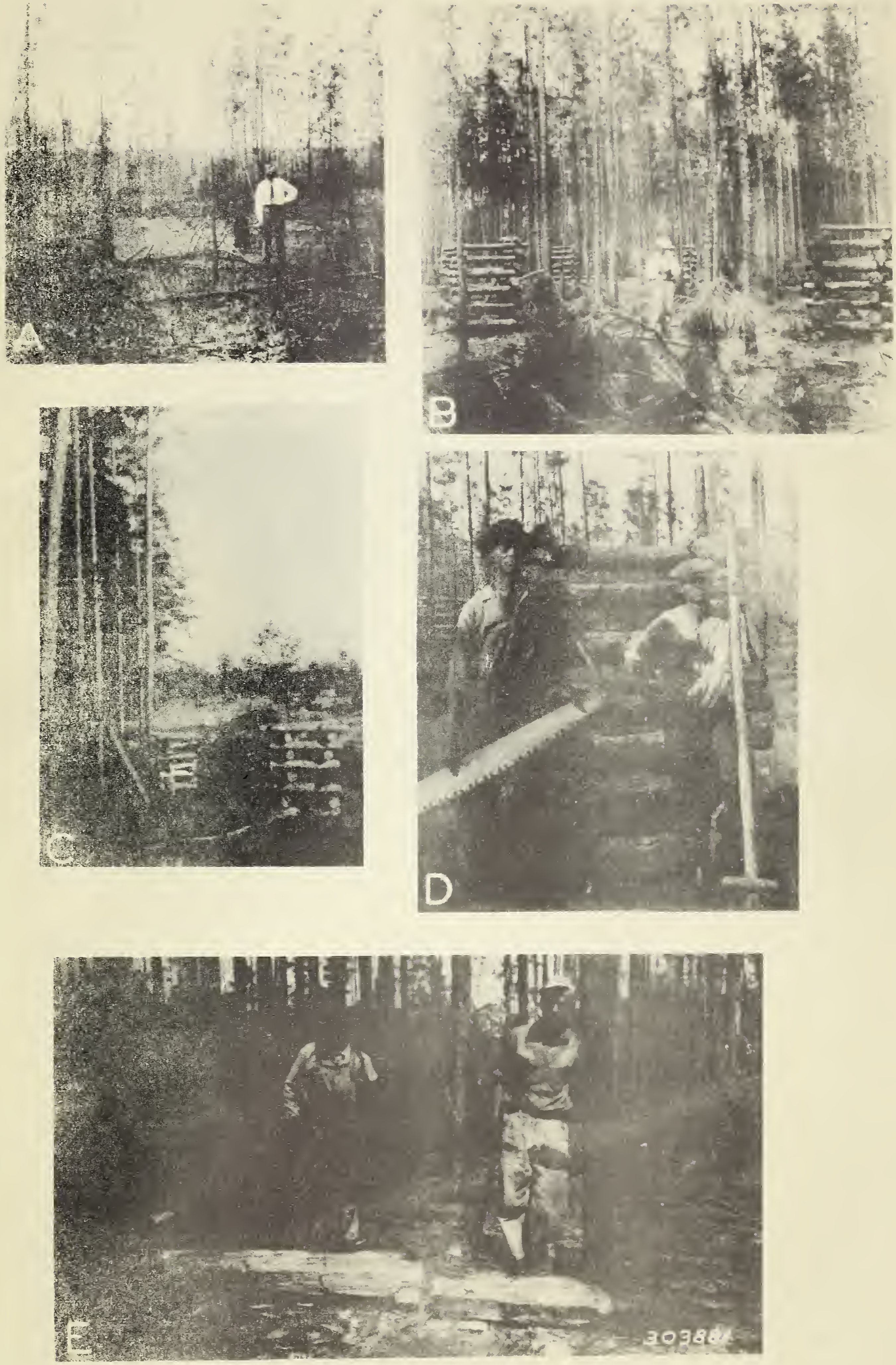

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PLATE II

PULPWOOD TRANSPORTATION

A. Loading car from a pulpwood truck in the shortleaf-loblolly-pine-hardwood type. Pulpwood production is largely performed by hand labor. (F.S. Neg. 303634.)

B. Loaded barges ready for the tow to the pulpmill. A large proportion of the wood supplied pulpmills in the naval stores region arrives by barge. (F.S. Neg. 303463.)

SCENES OF POLE PRODUCTION AND LOGGING IN THE NAVAL STORES REGION

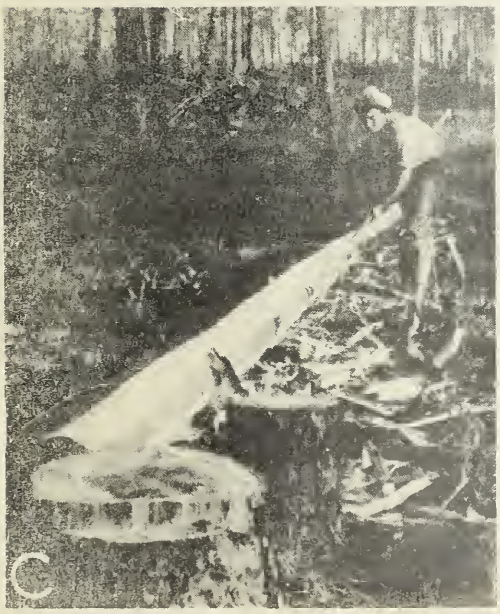
C. Peeling poles in a longleaf pine stand. Poles, logs, and pulpwood, in the order named, are removed from his timber land by this operator. (F.S. Neg. 332735.)

D. Loading small poles with a "cross-haul." The rejected poles, in bottom of the load, are taken to the sawmill unpeeled for conversion into lumber. (F.S. Neg. 332733.)

E. Logs as long as 80 feet are hauled by trucks and trailers in the naval stores region. The trucks can travel through most of the area with a minimum of road preparation. (F.S. Neg. 332731.)


A


B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